Reading and Listening in Learning
by the Blind
Investigated by Carson Y. Nolan
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PROGRESS REPORT

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Reading and Listening in Learning by the Blind

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This Progress Report describes the eight studies completed under this project during its first three years. Results of the first study indicate that listening is related to educational and personal variables of the blind in much the same way as for the sighted. Findings in the second study identify many problems in the use of recorded texts by the blind. The last six studies compare reading and listening comprehension for materials representing the curricular areas of literature, science, and social studies. Blind students in both elementary and secondary school programs participated. The general findings are that listening yields far more knowledge per unit of practice time regardless of the curricular area studied.

Chapter I

Introduction

The Problem

For the education of the blind, two primary communication modes are available, reading and listening. While auditory communication has always played a large informal role in the education of blind children, the schools have emphasized reading in the form of braille and large type books. Unfortunately, reading rates for braille and large type are quite slow. The average blind high school senior reads braille at about 86 words per minute (wpm) (Ethington, 1956), as compared with 250 wpm (Harris, 1947) for his sighted peer. Average reading speed for legally blind large type readers was found to be about 90 wpm (Nolan, 1959). Consequently, completing an assignment takes much longer for the blind student and his slow rate of progress in reading is often held responsible for the frequent educational retardation found among this group.

Greater utilization of auditory communication, where appropriate, would do much to decrease the time needed to cover a study assignment. Recordings made for the blind at the American Printing House normally approximate 175 wpm and recent research (Foulke, et. al., 1962) has indicated that the blind can successfully comprehend auditory material presented at 275 wpm. Therefore, widespread provision of text materials in recorded form could be a great advantage. However, it is first important to identify the types of educational information that can be efficiently presented in this manner and appropriate techniques for its reproduction and use.

Previous Research on the Relative Efficiency of Listening & Reading

Many researchers have compared the relative efficiency of listening and reading by the normally sighted. Witty and Sizemore (1959) have published an extensive review of this research. General findings are that listening results in superior comprehension for children in the elementary grades and at low MA levels while reading results in superior comprehension in the secondary grades and at higher MA levels. Analysis of the results of these studies by the authors of this report indicates that the relative superiority of listening and normal reading may be contingent upon reading rate. That is, when listening rates exceed reading rates the former results in superior comprehension. However, when reading rates exceed listening rates, then reading results in superior comprehension. The comparative usefulness of reading and listening has been found to vary with a number of factors including the intelligence of the group, their reading ability, difficulty of material, length of material, and familiarity of material.

Several studies in this area have used visually handicapped students as subjects. Lowenfeld (1945) compared comprehension of blind children in grades 3-4 and 6-7 for lessons presented in braill and recorded form. Braille reading took three times as long as listening. Comprehension of recorded material was significantly superior for children in grades 3 and 4. For grades 6 and 7, no

difference was found for comprehension of stories, while comprehension of text material was significantly greater for braille reading. However, these latter differences were slight and in view of the shorter time needed for listening, appear to be of little practical significance. In a second study, Nolan (1963) compared the comprehension of matched groups of subjects in grades 6-12 who read or listened to a short passage of scientific material for 2, 4, or 5 consecutive days. The comprehension of the listening groups did not differ from that of the braille reading groups, however, the former spent only about 33% as much time in practice as the latter.

Time savings through listening can be even greater as evidenced in a report by Foulke, Amster, Nolan, & Bixler (1962). This study compared groups of blind students for comprehension obtained through braille reading and listening at word rates as high as 325 wpm. For scientific material, no differences existed between braille readers and students listening at word rates as high as 275 wpm. Students in the study read the brailled literary material at 70 wpm and the brailled scientific material at 57 wpm. Therefore, with no loss in comprehension, efficiency of communication was increased by a factor of more than three for the literary material and by a factor of almost five for the scientific material.

These research findings when considered in reference to the problem described above led to the formulation of a research project with the following objectives:

(a) To determine the relative efficiency of listening and braille or large type reading as a means of learning subject matter of different types.

(b) To determine the relative efficiency of different rates of auditory communication for learning subject matter of selected types.

(c) To identify listening techniques useful for the blind.

The Organization of this Report

The intent of this report is to describe the progress made in the project during the period 1 September 1963 through 31 August 1966. The next three chapters will describe in detail the eight studies completed during the reporting period. These chapters will be followed by a final chapter which will deal with general conclusions and future research needs. The first two studies to be reported will be concerned with the study of listening behavior. The following six studies will compare listening at normal word rates with braille or large type reading as a means of learning subjects from three different curricular areas.

Chapter II

Variables Related to Listening by the Blind

Research on normally sighted students has revealed a number of relationships among measures of listening ability, academic achievement, mental ability, and listening techniques. In a study of fifth grade pupils, Hollow (1955) reported the following correlations with listening ability; reading comprehension .55, reading vocabulary .47, spelling .33, arithmetic reasoning .56, and intelligence .42. For another fifth grade group, Baldauf reported correlations of scores on the STEP Listening Test with those of the Stanford Achievement Battery ranging from .30 - .57 and a correlation of the listening measure with the Otis Mental Ability Test of .59. Similar results for high school students are reported by Murphy (1962) who correlated grade point averages with scores from the Brown-Carlsen Listening Comprehension Test and obtained relationships of .53 for English, .41 for social studies, .52 for science and .49 for mathematics. Correlations between mental ability and listening ability were found to be .79 for blind high school students and .66 for sighted high school students be Hartlage (1963).

The purposes of this study are exploratory. They include a tryout of the STEP Listening Test with groups of blind students and determination of the relationships of the obtained measures with measures of academic achievement and mental ability. In addition, interviews were conducted with blind students in an attempt to elicit material concerning comparability of reading and listening as a means of study.

The Method

Subjects. One hundred thirty white and 100 negro students in grades 4-12 served as subjects. These pupils were enrolled during 1963-64 in the separate schools for the white and negro blind in what was then the North Carolina State School for the Deaf and Blind.* All were braille readers. Descriptive data for the subjects when broken down by grade are given in Table 2.1.

Table 2.1

Data Describing Subjects Participating in the Study

Grade	School		Listening Test	Age	IQ	Sex M	Sex F	No.
4	White	Mean	47.05	12.68	90.23	11	11	22
		σ	13.66	2.83	14.96			
4	Negro	Mean	33.23	12.92	77.00	15	11	26
		σ	9.57	1.73	12.45			
5	White	Mean	51.33	14.47	86.44	16	20	36
		σ	10.97	1.85	12.96			

(Table continued on next page)

* Now the Governor Morehead School

Grade	School		Listening Test	Age	IQ	Sex M	Sex F	No.
5	Negro	Mean	37.42	14.45	74.33	5	7	12
		σ	9.61	1.16	12.55			
6	White	Mean	60.20	15.60	89.50	7	3	10
		σ	7.30	6.03	11.77			
6	Negro	Mean	53.67	16.08	87.42	9	3	12
		σ	12.76	2.25	15.96			
7	White	Mean	57.42	14.25	108.50	5	7	12
		σ	8.42	.92	13.84			
7	Negro	Mean	35.00	15.64	78.17	7	5	12
		σ	11.90	1.07	8.81			
8	White	Mean	59.62	15.46	109.54	8	5	13
		σ	10.05	.93	12.54			
8	Negro	Mean	38.17	16.50	83.92	7	5	12
		σ	10.56	4.04	13.97			
9	White	Mean	56.27	18.13	98.00	12	3	15
		σ	7.87	1.59	14.45			
9	Negro	Mean	50.50	17.38	93.00	2	6	8
		σ	8.34	1.11	14.27			
10	White	Mean	45.00	18.70	107.10	5	5	10
		σ	9.87	1.90	12.85			
10	Negro	Mean	26.92	19.82	79.92	4	8	12
		σ	5.87	1.64	16.21			
11	White	Mean	48.50	22.00	102.50	2	0	2
		σ	9.50	.00	13.50			
11	Negro	Mean	29.75	19.25	78.50	3	1	4
		σ	7.76	2.86	7.09			
12	White	Mean	50.29	20.00	116.71	4	3	7
		σ	10.83	1.07	12.87			
12	Negro	Mean	29.50	24.00	91.00	2	0	2
		σ	.35	1.00	9.00			

Procedure. Several types of data were gathered describing the subjects. The method for data collection is related under each type

(a) Listening Test, Form B - Sequential Test of Educational Progress (STEP). This test is designed to measure ability to comprehend, interpret, and evaluate what is heard. The administrative

technique varied from normal in that the instructions, selections, and questions were recorded on tape by a professional Talking Book reader in the studios of the American Printing House for the Blind (APH). Usually these are read by the test administrator. The recorded technique was used to give greater control of test procedures. The students were tested in small groups (usually their grade group) by the experimenters who explained the purpose of the study and why the test was being given. The experimenter manually operated the tape recorder, stopping it after each question for a long enough period for students to answer each question in a brailled response booklet. Form 4B of the test was given to grades 4-6, Form 3B to grades 7-9, and Form 2B to grades 10-12.

(b) Stanford Achievement Tests - Form K - These tests were administered during April 1964 by school personnel. The procedures for administration and scoring of the braille forms of the tests were followed.

(c) Mental Ability Measures - The IQ score of each student was obtained from the school records. In each case the score recorded was of the most recent date. All tests were administered by the school psychologist. While most IQ scores were derived from the Verbal Scale of the Wechsler Intelligence Scale for Children, a few scores for children enrolled in the lower grade range were derived from the Interim-Hayes Binet.

(d) Personal Adjustment Ratings - Houseparents and teachers were asked to rate each student as Poor, Average, or Good in overall adjustment when defined as follows: "Personal adjustment consists of such things as getting along with our fellow students, teachers, and houseparents, taking care of our persons and belongings, and having the ability to apply ourselves to the task at hand."

(e) Visual Acuity Measures - A record was made of the most recent visual acuity measure found in each students school records.

(f) Listening Practices Interview - Semi-structured interviews were conducted with students falling in the upper and lower quartiles of the distribution of Listening Test scores. The purpose of the interview was to compare the listening behavior of good and poor listeners and relate these to the other data collected in the study.

Results

Table 2.2 gives data describing the results of administration of the Listening Test. White grade groups in all cases had median scores falling above the norm midpoint. Almost the reverse was true of negro grade groups all of whose norm scores save one fell below the norm midpoint. Use of the Fisher Exact Probability Test (Siegel, 1956) to test the hypothesis that the white and negro grade medians come from the same population reveals that this hypothesis is untenable. Therefore, significant differences in listening scores do exist between the two groups.

Inspection of the ranges for listening scores for the grades indicates that while the test discriminates widely among white students in most grades, it fails to do so for negro students in most grades. The reason for this failure is not apparent from these data.

Table 2.2

STEP Listening Test: Median Raw Scores, Ranges for Scores, and Mid-Percentile Scores for Grade Groups of Negro & White Students

	Negro				White			
Grade	Median	Range	Mid-Percentile	N	Median	Range	Mid-Percentile	N
4	31	18-53	18	26	48	21-70	55	22
5	38	16-54	19	12	54	27-74	52	36
6	54	28-71	42	12	58	51-75	55	10
7	31	17-59	20	12	61	40-69	91	12
8	35	22-57	18	12	62	37-72	83	13
9	54	37-61	56	8	58	41-74	67	15
10	26	18-37	11	12	43	29-63	61	10
11	28	21-42	11	4	48	39-58	70	2
12	30	29-30	8	2	55	33-60	84	7

In Table 2.3 appear rank order correlations between Listening Test scores and measures of mental ability and academic achievement. Those correlations for groups of white students appear to correspond to those previously reported in the literature in that positive relationships exist between listening ability and IQ and most areas of academic achievement. The data for the negro groups appears to depart somewhat from previous findings. Fewer relationships were found between listening scores and IQ and with scores from the achievement battery. This is particularly true for the reading and language subtests.

A question of interest was whether Listening Test scores were related to visual acuity. A crude test of this was made. White students and negro students were placed in two visual categories by grades. These categories were (a) visual acuity of light perception or less and (b) visual acuity of perception of hand movement or better. Mean Listening Test scores were then computed for each visual category within each grade. These means appear in Table 2.4 grouped accordnng to the form of the test from which they were derived.

The Listening Test means for each school and each form were then tested for significance of differences along the dimensions visual category and grade using analysis of variance. The data for Form 2B of the negro school was excluded because one cell of the design involved a single subject. In no case were signigicant difference found between the means for visual categories. Significant differences among grades were found for the Form 4B means in both negro and white schools.

Table 2.3

Rank Order Correlations of Listening Tests Scores with IQ Scores and Stanford Achievement Battery Subtests for Selected[a] Grade Groups of White and Negro Students

	White					Negro				
Grade / Variable	4	5	7	8	9	4	5	7	8	9
IQ	.54*	.42*	.76*	.90*	.41	.25	.63*	.58*	-.12	.27
Paragraph Meaning	.67*	.49*	.32	.69*	.62*	.08	.62*	.77*	.14	.50
Word Meaning	.66*	.54*	.76*	.62*	.42	.72*	.50	.47	.35	.73*
Spelling	.18	.09	-.11	.27	.09	-.11	.00	-.33	.26	.12
Language	.74*	.38*	.49	.48	-.29	-.03	.20	.13	-.30	.26
Arith. Reason.	.58*	.47*	.21	.62*	.50*	.23	.61*	.68*	.17	.49
Arith. Comp.	.54*	.49*	.05	.79*	.43	.21	.75*	.59*	.01	.43
Social Studies		.60*	.50	.60*	.56*					
Science		.80*	.46	.48	.55*					
N	22	36	12	13	15	26	12	12	12	12
*rho significant >0 at .05 level	.40	.32	.53	.51	.48	.37	.53	.53	.53	.53

aCoefficients were computed only for those grades where N $\geq$ 12.

Table 2.4

Mean STEP Listening Test Scores Grouped by School, Visual Category, and Grade

Visual Category	White School				Negro School			
	LP or less		HM or better		LP or less		HM or better	
Grade	Mean Score	N	Mean Score	N	Mean Score	N	Mean Score	N
4	44.67	6	49.23	13	33.46	13	33.00	9
5	54.75	16	46.62	16	39.14	7	36.50	4
6	59.80	5	61.50	4	55.50	4	55.60	5
Form 4B Mean	53.44		49.45		38.79		40.06	
7	51.67	3	58.25	8	41.75	4	31.33	6
8	61.00	5	58.75	8	34.00	4	40.25	8
9	56.29	7	56.50	10	47.00	2	47.00	3
Form 3B Mean	56.93		57.73		39.70		38.29	

(Table continued on next page)

Visual Category	LP or less		HM or better		LP or less		HM or better	
	Mean		Mean		Mean		Mean	
Grade	Score	N	Score	N	Score	N	Score	N
10	47.80	5	42.20	5	31.50	2	23.33	6
11 & 12	48.50	2	50.29	7	42.00	1	26.50	4
Form 2B Mean	48.00		46.92		35.00		24.60	

As indicated earlier, teachers and houseparents were asked to rate each student as poor, average, or good in overall personal adjustment. Agreement between ratings from these sources was moderate as indicated by a contingency coefficient of .52 for white pupils and .33 for negro pupils. Both the coefficients are significantly greater than zero at the .05 level of confidence and appear to express moderate degrees of relationship since the upper limit for contingency coefficients computed from 3 x 3 tables is a value of .816. Generally, distributions of ratings for white pupils were negatively skewed while those for negro pupils more closely approached a normal distribution.

Table 2.5

Mean Listening Test Scores Grouped by Composite[a] Personal Adjustment Ratings

	Composite Adjustment Score				
	2	3	4	5	6
White School					
Mean*	52.00	48.36	52.73	52.61	57.67
N	9	11	22	38	36
Negro School					
Mean**	28.57	31.24	34.28	40.19	49.00
	7	17	28	31	14

a A composite rating is the sum of the ratings of the teachers and houseparent.

* Differences among these means are significant at > .01 < .05 level of confidence.

** Differences among these means are significant at .001 level of confidence.

It was of interest to estimate if a relationship existed between Listening Test score and the adjustment ratings. In order to do this, the two adjustment ratings for each pupil were pooled yielding composite ratings with a possible range of two through six. Means were then computed for the listening scores of pupils falling within each composite category. These means appear in Table 2.5.

A high composite score is associated with good adjustment.

Inspection of Table 2.5 reveals some trend for higher Listening Test means to be associated with higher levels of adjustment ratings This trend is especially marked for the negro pupils. Tests for significance of mean differences using analysis of variance techniques reveal that differences for the white means barely fail to reach significance at the .05 level of confidence while differences for negro pupils are highly significant (.001 level of confidence).

Interviews were held with students falling in the upper and lower quartile of the distributions of Listening Test scores for each score form. The purpose of the interviews was to compare the listening behavior of good and poor listeners and relate this to the data describing other variables. The major finding of the interviews was that the students in this research engaged in almost no formal study using recorded texts or other materials. Therefore, the goals of this part of the research were not achieved.

Discussion

Generally speaking, the STEP Listening Test appears useful with visually handicapped students. A wide range of scores was obtained. In terms of the norms of the test, the white students appeared to be superior to the sighted norm groups in listening skills since all mean mid-percentile scores for these grade groups were above 50. Such was not the case for the negro groups studied. All of these but one had mean mid-percentile scores falling considerably below the 50 percentile point for the test norm.

When Listening Test scores were correlated with scores of academic achievement and mental abilities tests, results for the white groups similar to those found in the literature for normally sighted groups were observed. Although the groups were small, the repetitive nature of these findings lends credence to their reliability.

The correlational picture for the negro group was less striking. Fewer significant correlations appear. Although this may be a function of the group subject numbers, inspection of the correlations in Table 2.3 reveals that more of the correlations for this group are numerically small. The lack of correlation of the Listening Tests with the achievement scores in the verbal areas plus the lack of correlation with a verbal measure of mental ability may pinpoint the source of the poor showing of the negro students on the STEP Listening Test. For these students in a southern state, the retardation in vocabulary development (Hayes, 1938) that often characterizes blind students is probably compounded. This, plus the dialectical differences in verbal behavior observed by the experimenters may be the sources of the severe differences found among the white and negro groups. These findings have great implications for attempts to use eduational material presented aurally to offset reading deficits encountered in environmentally deprived groups.

One bit of evidence relative to growth of listening ability was obtained. For both groups studied, significant increases in listening ability appeared between grades four and six. No such systematic and significant increases were observed for the grade grouping 7-9 and 10-12.

No evidence of relationships between listening ability and visual ability was found. Although visual categorization of subjects was crude (light perception or less/perception of hand movement or better), in no case were listening means between visual groupings significantly different nor were trends for differences apparent.

Some evidence of relationships between measures of listening ability and personal adjustment was found. Students rated as better adjusted received significantly higher listening scores. Since the definition of personal adjustment was couched in terms of adequacy of performance within a school environment, it is not too surprising to find that the better students are the better listeners.

While no massive use of recorded materials in formal study had been expected, the authors were surprised to find that use of such materials was almost nil. Uses reported were restricted to listening to Talking Books supplied by the Library of Congress for the purpose of making book reports. Surprisingly, even recreational use of these materials did not appear great. Failure to use auditory materials with their greater word rates of communication represents loss of one of the few opportunities for overcoming educational deficits facing the blind. However, inquiry subsequent to this study reveals that this is not an uncommon occurrence.

Chapter III

Interviews of Users of Recorded Texts

In a survey of study habits of college students who were blind, Carter (1962) reports that about 86% of the study of these students was through listening. Of this, 43% involved material read directly to the student by sighted readers and 43% involved material in the form of discs or tapes. Methods suggested for use in study through listening included (a) taking notes while listening; (b) use of a tape recorder to selectively record important parts of material; (c) development of a recording habit through listening a great deal, selectively re-running important passages, budgeting time for listening and development of techniques; and (d) learning to concentrate while listening to recordings. While these suggestions appear quite positive, exactly how to accomplish them is not very clear.

One goal of the present project was the identification of listening techniques useful to the blind. Interviews with blind high school students experienced in the use of recorded text material appeared to be a fruitful initial source of information for this purpose. The outcome of such activity is described in this report.

Method

Subjects. Twenty-six legally blind students who were enrolled in educational programs coordinated by the New Jersey Commission for the Blind were interviewed during July 1965. During the previous school year the grade placements of these pupils had ranged from grade nine through high school post graduate. Twenty-one of the pupils were braille readers while the remainder read large print. All students had used at least one recorded text during the previous school year. All recorded texts used had been produced by volunteer groups. The group had an average of three years experience in use of recorded texts. A breakdown of the group by reading medium, sex, and grade is given in Table 3.1.

Table 3.1

Grade and Sex of Subjects Interviewed

	Braille					Print				
	9	10	11	12	PG	9	10	11	12	PG
Males	4	3	2	2	2	1	1	2	0	0
Females	2	0	3	3	0	0	0	1	0	0

Procedure. At the time of the interviews all subjects were enrolled in summer programs at Camp Marcella, Marcella, New Jersey, or at the New Jersey Commission for the Blind Training Center, Newark. Prior to being interviewed the students were called together in small groups, the purpose of the study explained to them, and the STEP Listening Test Form 2B administered. The method for administration of this test was described in Chapter Two.

During the ensuing two or three days each student was individually interviewed for a period of approximately 50 minutes. The interviews, which were semi-structured and quite informal, were conducted in rooms set aside for that purpose. The results of the interview were noted by the interviewer on an interview form (see Appendix). The total interview was also recorded on tape.

Results

1. Scores on the Listening Tests

Results of the STEP Listening Tests revealed the subjects to be a superior group of listeners with their mid-percentile ranks ranging from 26 to over 99.8 and the group median being 85.5. Table 2.2 presents mid-percentile ranks by grades.

Table 2.2

Mid-percentile Ranks Earned on STEP Listening Tests by Grades

9	10	11	12	PG
70[a]	26	40[a]	84	94
76	46[a]	40	97	97
84	56	46	98	
93	97	78	99	
97		80[a]	over 99.6	
over 99.4		87		
over 99.4		91		
		over 99.8[a]		

a print readers

2. Findings from the Interviews

A. Materials Used

1. Subjects for which recorded texts were used

Fourteen different school subjects were named as having been studied from recorded textbooks with the majority of students having used recordings for both English and history. Although the English studied was primarily literary in nature other areas mentioned were grammar, writing prose, and English 3200, which is a programmed approach to teaching grammar. Other subject areas for which recorded texts had been used were: economics, sociology, world culture, religion, French, Spanish, journalism, vocational agriculture, biology, science, physics and chemistry (a combined course), and algebra. In addition to these, supplemental books of a non-text nature were also used.

2. Student preferences for recorded and printed texts

Opinions as to which subjects might best be studied in recorded or printed form were varied and sometimes conflicting as shown in Table 2.3.

Table 2.3

Number Preferring Texts in Either Media for Different Subjects

Recordings	Either	Books
6 literature	1 literature	11 math
5 history	1 history	9 foreign language
3 foreign language	1 foreign language	6 English grammar & spelling
2 English grammar	1 health	4 history
1 economics	1 science	3 science
1 science	1 biology	2 chemistry
1 math		1 physics
1 psychology		1 geography
½ philosophy		
		2 all subjects
		1 everything but literature

A reason given for the recommended use of recorded material for literature and history was that both of these subjects require a great deal of reading. The advantages of hearing the pronunciation of names and places was another reason why some thought it the better medium for learning history. Hearing the pronunciation of foreign words was considered of great educational value in the learning of the language by some students. Others felt that bound books provided the best means of learning a foreign language because they could present the grammar, spelling, and accents of the language with greater facility than recordings. Ideally, perhaps the two media could be used to complement one another.

Similarly, some students felt English grammar and spelling could be learned more readily when read as frequently there are lists of words or rules to be learned.

Most of the students agreed that math and science should be presented in book form because their subject matter is such that a student might need to go over it a number of times and refer back to it. One student expressed the opinion that geometric figures could not be meaningfully explained while another commented that it was easier to picture the problems of math and science when read than when heard.

Two general criticisms of the use of braille books concerned the amount of time required to have them transcribed and the amount of space required to store them. Recordings on either discs or tapes have the advantage over braille on both these counts as comparatively little time is required to record them and, physically, they are much smaller.

B. Study Environment and Equipment

1. Equipment used to study

When asked whether the recorded textbooks used were on discs or tapes, 17 subjects replied discs, three tapes, and six both.

Practically all of the discs used were of the embossed variety produced by Recording for the Blind. Of the students studying from discs all but one reported the phonograph used was the Talking Book Reproducer. The one exception said that her machine had been given to her by the Commission (this was probably also a Talking Book Reproducer). These monaural machines were designed primarily for recreational listening. They are operated by two control knobs mounted on the turntable deck. One knob is a combined control for tone and starting and stopping the turntable motor. The second knob is a volume control and also turns off the power to the machine. The pickup arm is positioned manually. This machine was not designed to produce Soundscriber type records.

Although only nine of the students interviewed reported having used taped texts within the preceding school year, 14 said they had tape recorders, and four stated that they also had a second tape recorder. These recorders were commercially available types with tape deck mounted controls.

Most of the students (73%) indicated that while they studied from recordings they had at hand some means by which to write. Some used braillewriters, others used slates and styli, others used typewriters, while still others used paper and pencil. Many used some combination such as a braillewriter for their own notes and a typewriter for work that had to be turned in to their teacher.

Half of the students interviewed said they owned earphones which they used at least occasionally. Only a few reported using auxiliary loud speakers.

2. Student comments on equipment

About one-fourth of the students disclosed that they found the quality and condition of the discs quite poor. Part of this problem stemmed from the fact that the Talking Book Reproducers, which practically all the students were using, was not designed to play the type of disc they used. Consequently, the needle was prone to stick in the grooves of the record or jump across grooves. Field expedients such as weighting the pickup arm with a coin or placing a wedge under a corner of the machine were utilized to offset these difficulties. These problems reported were similar to those reported by large numbers of college students in the study reported by Carver (1962).

3. Place of study

The interviews revealed that only one student had been able to study from recordings at her school. All others had to study from recordings at their homes. Bedrooms were the most popular sites, being by far the most frequently named place of study, although recreation rooms, basements, sitting rooms, studies, and dining rooms were also named. Apparently, the primary requirement for a place in which to study was that it be a place where the student could be alone and have relative quiet.

A variety of physical arrangements for study were disclosed. Several students remarked that they placed recorders and Talking Book Reproducers on either the floor or their beds because they lacked more appropriate places to put them. Others said that they had their equipment scattered around their rooms. A few even admitted that they had no regular place to study which meant they had to carry their equipment from place to place.

4. The problem of environmental noise

The majority of students interviewed claimed that they were not unduly disturbed by noise when studying from recordings. However, it was apparent that the reason for this was that most of the students had taken steps to avoid noise prior to studying. Such steps included closing the door of the room in which they were studying, using earphones, or turning the volume on their playback equipment up high enough to drown out any other noise.

Extreme noise, television, the telephone ringing, and people talking were the types of noise mentioned as disturbing. The interview evidence indicated that when a student found the material he was studying interesting he was not easily disturbed whereas when it was considered dull, most anything might serve to distract him.

C. Textbook Formats

1. Present formats for recorded texts

Formats for recorded texts vary somewhat depending upon the recording agency and the medium, disc or tape. However, the following description (Recording for the Blind, 1964) of a format followed for disc recordings is illustrative of the general area.

The present day practice is to record textbooks sequentially almost exactly as they are printed. On most disc recordings a blank space of 1/8 inch is left between chapters to identify chapter breaks. Page numbers are embedded in the text and are announced at the beginning of the first full sentence on each page. Footnotes are generally read immediately following the sentence to which they refer.

Each disc is numbered in braille. Its envelope gives, in braille, the author's name, the book title, chapters on the disc, page numbers, and the readers initials. In addition, the envelope states on which disc and what side the initial chapter begins.

The Table of Contents for the book is recorded twice. First it is read at the beginning of the book without reference to disc numbers then again at the end of the book with the addition of appropriate disc numbers. The Index of the book is rarely recorded.

2. Student comments on the table of contents

Many, but not all, recorded books were reported to have a table of contents. The table of contents was usually recorded on a separate disc or tape or on one side of a disc or tape. However, for some books, content identification was restricted to notations for chapters and/or pages marked on the recorded discs or tapes themselves or on their containers. The irregularity of presentation of content information constituted a problem for users.

About half of the students interviewed said they used the recorded tables of contents while the other half said they did not. One student summed up the feelings implied by several, six, with the remark that recorded tables of contents were too gross for use.

Several students suggested that a print or braille table of contents would be quicker and easier to use than a recorded one. Such a table should give the disc(s) or reel(s), side(s), and pages of sections and/or chapters. It was also suggested that it would be helpful if the discs or reels and their containers were similarly marked in both braille and print to indicate the contents of each side.

3. The problem of finding a particular place in a book

More than half the users interviewed reported problems in this area. If the student knew the page number or even the chapter number and the book had an adequate table of contents, the student could immediately determine the side of the needed disc or tape required. He would then estimate the approximate point in the recording where the material might appear and through trial and error search procedure locate the spot. Nine students commented on use of such techniques. Some students reported that as their assignments progressed straight through the text, they would simply leave the disc or tape on the player and proceed from the previous stopping point. Two students used the assistance of a sighted person, who supplied place finding information through reference to the print original for the text.

Where a book was not adequately referenced and no outside help available, the trial and error search for material was reported to be time consuming and laborious. Search for location of material, therefore, became unfeasible because of the time involved. In view of this problem, many students found it more efficient to summarize the recorded text thoroughly in note form upon original study and then refer back to the notes rather than the recorded text for subsequent study.

4. Textbook format, vocabulary development, and spelling

Frequently when a new word is introduced on a recording it is pronounced, spelled, and defined in either a footnote or a glossary. When this method is used a student has essentially the same opportunity to learn the word as when it is presented in a bound book except that the glossary of a recorded book is not as handy to use.

When asked, "What do you do when strange words occur?" the majority of students interviewed said if they were not defined on the recording they usually looked them up or asked, as in class, the meaning of the term. Sources for looking up the word were the dictionary, the glossary, and the ink-print textbook. A few students commented they could usually infer the meaning of a word from its context.

Similarly, when asked, "How do you learn to spell new words?" practically all of the students replied they either looked them up or inquired when not spelled on the recording. When the word in doubt was a proper name the print textbook was the most common reference source.

Teachers, families, and friends were all named as sources of inquiry. Several students said they would ask a sighted person to look up the term in question. Obviously, a dictionary in the medium that a student can use himself should be on hand for those studying from recordings. A thesaurus would also be beneficial.

5. The problem of nonverbal graphic displays

In an effort to determine the usefulness of recorded descriptions of maps, graphs, and charts, students were asked how they dealt with such material. Ten students said they were of little or no use and they customarily skipped over them. Five other students stated they found such descriptions quite useful with one person going so far as to say that a well read diagram was more meaningful than a braille diagram. Nine students remarked that they

frequently found it necessary to use some form of supplemental material in order to understand the graphic. The supplemental material usually used was the braille or print edition of the text although braille books of maps and especially brailled charts were also mentioned. Several students said they had a sighted person look the graphic up and explain it to them. Perhaps the real problem in this area is the clarity, accuracy, and adequacy with which the graphic is described. As one student stated, sometimes the reader's description is meaningful and sometimes it is not. Only one student attempted to actually reconstruct the graphic from its description.

D. Study Techniques

1. Learning how to use recorded texts

Twenty of the 26 students reported that they had never received any instruction as to how to study from recordings. Six reported receiving some personal instruction (usually from Commission counselors) and three mentioned receiving recorded instructions on care and use of the Talking Book Reproducer. Only two students reported ever having discussed study techniques with other recorded textbook users.

2. Scheduling of study and time requirements

Study habits appeared to be primarily a function of subject matter and assignments. Most of the students interviewed indicated they made an effort to keep up with their school work but whether this was done by studying a subject daily for 30 minutes or once a week for two hours was determined by whether their assignments were short daily ones or longer weekly ones.

Literature was generally taught to the students in this study cyclicly with other areas of English, as grammar. Many of the students reported that they preferred to read a complete story, play, or poem at one time, if not too long, rather than break it up and, consequently, their study periods varied in direct proportion to the length of what they were reading. The total time spent studying literature during a sitting varied from about 30 minutes to over two hours. Whether the material was heard once or more than once seemed to be a matter of individual taste.

The four students interviewed who were studying science all reported they listened to at least parts of their assignments more than one time. As with history, their personal study habits varied with two of the students claiming to study on a daily basis, one studying twice a week, and one admitting that he only studied when required to write a paper or take a test. Those who studied on a daily basis did so for periods of about 30 to 60 minutes.

The one student studying algebra from a recording said it was of little use to him. He resorted to using a reader to read problems from the print text directly to him. These he reported working in his head.

3. The problem of attention

A problem encountered by many users of recordings was that their minds were prone to wander while listening. Even brief lapses in attention were reported as causing significant losses of information. This, then, could only be remedied by replaying the section previously not attended. Note taking was offered as the best

solution to the problem of keeping attention focused on the recorded material.

Approximately two-thirds of the students interviewed admitted they sometimes became sleepy while listening to recordings and occasionally even dozed off. This usually occurred when listening to material considered uninteresting or when studying late at night. Reader style was also mentioned as a cause for sleepiness. Quite a number of suggestions were offered for combating the problem of sleep. The most frequently mentioned solutions were to take notes (actively engage in study) and to sit rather than lie down. In talking with the students it became obvious that many of them sometimes listened from a prone position. Several students suggested that after listening for awhile it was beneficial to either take a short break or to do something else for a while. Two students said it helped them stay alert if they did something else while listening. One of the two said she liked to knit or sew while listening and the other said he liked to work with his coin collection. Others remarked that the best way to stay awake was to plan not to study late at night or when tired. One suggested that a short nap just prior to studying was helpful. Two unique suggestions were to fluctuate the volume up and down and to turn it low enough to force the listener to be attentive in order to hear what was said. Other methods of combating sleep mentioned were: avoiding the use of earphones, studying in a cold room, eating, physical exercise, and self-discipline.

4. Note taking

As indicated above, the process of taking notes was emphasized as a means of turning the listening experience from a passive one to an active one and compelling focus of attention. Note taking was the most predominant habit of study mentioned by the group. It was interesting to find that when the distribution of Listening Test scores for the group was equally split at the median, 92% of the group scoring in the upper half of the group reported taking notes as opposed to 46% of the group falling in the lower half. Test of these differences using the Fisher Test for Exact Probabilities revealed them to be statistically significant at the .03 level of confidence.

Most of the students interviewed felt they could remember literary selections well enough without the benefit of notes. However, a few students mentioned they might list the characters, note the authors, or briefly summarize the story. Only one of the 18 students studying literature claimed to take more extensive notes; her's being of the type that included tone, mood, imagery, and message of poetry and all important facts included in stories.

The notes taken for history seemed to fall into two general categories which sometimes overlapped. Some were of the outline type, often using headings taken directly from the text, and others were notes of central ideas or pertinent facts. One student mentioned making vocabulary notes for history. Over half of the students studying history took notes of some kind.

Notes taken for sociology, economics, and world culture fell into the same categories as history.

Several of the students studying different subjects said they were required to answer questions that were either listed at the end of chapters or given by their teachers. These questions were either retained for their own use or turned into their teacher and sometimes returned for their own use.

Not considering the answering of questions as a form of note taking, it was startling to learn that of the 26 students, 11 took no notes while studying from recordings and eight others took notes for only some of their subjects. These students relied on what they could learn by listening, both in class and to their books, and on their class notes. Subjects named for which some students did not take notes included both English literature and grammar, journalism, Spanish, French, religion, history, sociology, science, physics and chemistry, biology, and vocational agriculture.

Notes made from recordings were usually written rather than recorded. Some students made them as their playback equipment played while others stopped it while they made their notes and started it up again when they had completed the note.

Because of the difficulty of finding the place when referring back to recorded material, a couple of students noted it was necessary to take more notes when using recorded textbooks than when using bound ones. The main use of notes, be they taken in class or while studying, was for test review. However, they were also used for class discussion, for reference, and for the writing of reports.

Nineteen of the 24 students who were expected to take tests studied their notes for test review. Other ways in which these students studied for tests were to listen to either the entire selection or parts of it again, study the questions at the end of chapters, and review with other students or in class. By far the most common form of study was from notes.

5. Use of earphones in study

Quite a number of students reported they used earphones when the surroundings were noisy or when they wanted to avoid bothering others, as when studying late at night. Many complaints were expressed in regards to use of earphones. Others mentioned that earphones were uncomfortable and restricted ones movement. One girl complained she did not like to use them because they squashed her hair. Half of the students interviewed never used earphones. Of the ones who did, their amount of use ranged from slight to all of the time. One student commented he felt he could study better using earphones because they blocked out some of the surrounding noise. Two others noted that a scratchy disc sounded better with earphones than through a loud speaker.

E. The Comparative Usefulness of Recorded and Printed Texts

It became obvious after talking with the students that the majority of them found many disadvantages to studying from recordings. The disadvantages cited were that material presented orally is not remembered as well as that which is read, that it is necessary to take more notes when studying from recordings and that it is more difficult to take them, that it is harder to concentrate while listening than while reading, that vocabulary and spelling are not presented in a way conducive to learning on recordings, that it is

harder to find a particular place in recordings, that there is no index in recordings making it more difficult to find specific topics, that one is less likely to study or review when using recordings, that recorded materials cannot be used at school, and that use of recordings requires more time than use of bound books. In direct contradiction to the latter, other students noted as an advantage to the use of recordings thay they provided a faster means of study. Both statements can be true and would be determined by the student's reading rate or techniques for study. Other advantages mentioned to the use of recordings was that they provided an easier means of study and that material heard could be remembered better, which is probably particularly so for students who are not proficient readers.

Several students commented they felt they could learn equally well via either medium or that they had no real preference. Most of the students in this study had been issued both bound and recorded texts for the subjects under study. Apparently, many found it experient to use both, the bound one being used by either themselves or by a reader or other helper. One student commented that he liked to use his print book at school and the recorded version at home.

Discussion

The most immediate impression given by the interview results is that many incompatibilities exist among the playback equipment, recording formats, writing equipment, and the techniques students utilize. For example, it requires two hands to operate a brailler in note taking leaving no hands available to operate playback equipment as it is currently designed. This makes it appear that use of recorded texts, as described by these students, is no more than a makeshift expedient. For it to become any more than this would require development of a system of playback equipment, recording formats, and user techniques specifically oriented to the task of study. The interview material provides partial information needed to describe this task. However, additional data are needed.

Some of the specifications for adequate playback equipment can be inferred from students comments. A primary need seems to be for control systems which can be knee or foot operated. Disc equipment should have both forward and backward movement allowing for easier place finding and repeated listening. A wide range of speeds (perhaps continuously variable) should be available to help in scanning and place finding.

Possibilities for development of recording formats can also be inferred. Techniques are needed for making page numbers and other entry information stand out from the text so as to be obvious for search purposes. This material should be presented at much faster speeds than the text material to facilitate search. Textbooks should have braille or large type supplements for table of contents, indexes, glossaries, and certain graphics.

Techniques for use of recorded text materials should be described and students instructed in these. For many students the listening experience appeared to be passive to the extent that little learning seemed possible. The student should actively engage the

material. Note taking is one means of doing this. Although it appears that recorded note taking techniques may be most efficient, almost no use of these was reported. It seems that many of the techniques suggested by learning theory and described for use in study by reading would be applicable also for listening. This information should be made available to blind students. The fact that students reporting active techniques (note taking) proved to be better listeners supports these conclusions.

Some types of subject matter do not appear amenable to presentation in recorded form. Among these are mathematics and some of the sciences.

Study is needed to develop criteria for determining which kind of texts should be recorded.

Chapter IV

Relative Efficiency of Reading and Listening

Having speculated that the relative superiority of learning by reading or listening might favor the mode providing for the most rapid input of information with normally sighted groups, it would follow that listening might be the better mode of learning for visually handicapped groups whose reading rates are slower than normal speech rates. The studies reported in this chapter test this idea.

Efficiency was selected as the most realistic and practical measure by which to compare learning by reading with learning by listening. Although it is known that listening is a faster means of communication for the visually handicapped than is reading, the medium providing for greatest efficiency of learning, in terms of amount learned and time spent, previously has not been determined. Realizing that the medium of greater efficiency might vary with content, learning was evaluated for three types of subject matter, namely, literature, science, and social studies.

In addition to reporting primary findings on the relative efficiency of learning through reading and listening and the results of the differences in learning between modes of presentation, amount of practice, type of student, and grade level of student; secondary findings of reading rates will also be reported as there is a wide general interest in them. Braille reading rates have been reported previously; but, to the knowledge of the authors, no such rates for legally blind print readers have ever been reported.

Research Design

Six separate but parallel studies were conducted; literature, science, and social studies being evaluated for users in both the elementary and secondary grades. The research design was such that data from each of the six groups could be analyzed by separate analyses of variance of the treatments x treatments x treatments x levels type (2 x 2 x 2 x 3). Treatments under study in each of the six analyses were mode of learning (reading Or listening), type of reader (braille or print), and amount of practice (one-day or three-day)[1]. Grades constituted the three levels in each study. In the studies of elementary groups the levels consisted of grades four, five, and six. In the study of literature, the high school group's levels consisted of grades nine, ten, and eleven. In the research on science and social studies using high school groups, the levels consisted of grades nine and ten and grades eleven and twelve combined. Eight subjects were utilized in each cell of each study. A total of 192 subjects was required for each. A layout for the experimental design is presented in Table 4.1.

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[1] The original design of this study included five-day reading groups and five-day listening groups. However, as data were collected for literature, the first subject matter under study, it became obvious that learning was not increasing beyond the third day; therefore, the two five-day groups were discontinued. Learning of science and social studies might have increased beyond the third day.

Table 4.1

Model for the Treatments x Treatments x Treatments x Levels Design Used in the Six Studies

		Braille Students						Large Type Students					
		Readers			Listeners			Readers			Listeners		
	Levels	a	b	c	a	b	c	a	b	c	a	b	c
Practice	1-day	8	8	8	8	8	8	8	8	8	8	8	8
	3-day	8	8	8	8	8	8	8	8	8	8	8	8

The two studies concerning literature will be described first, next the two of science, and finally the two of social studies. These findings will then be related and discussed at the end of the chapter.

Literature

Literature was the first of the three subject matters to be researched. Data for it were collected during the 1964-1965 school year.

Method

Subjects. All students in the two studies were legally blind. Braille students participating were required to have read braille for a minimum of one year.

Subjects were from public school systems of Atlanta, Georgia; Denver, Colorado; Philadelphia, Pennsylvania; Delaware County, Pennsylvania; and Montgomery County, Pennsylvania; and residential schools for the blind in Arkansas, Florida, Georgia, Indiana, Iowa, Kentucky, Louisiana, Michigan, Oklahoma, Tennessee, and Texas. Table 4.2 shows the per cent of braille and print readers at high school and elementary levels from public and residential schools who were used as subjects in the major analyses of the subject matter.

Table 4.2

Literature

Percent of Braille and Print Readers from Residential and Public Schools in Elementary and High School Groups

	High School		Elementary		Total	
	Residential	Public	Residential	Public	Residential	Public
Braille	88.5	11.5	84.4	15.6	86.5	13.5
Print	82.3	17.7	70.8	29.2	76.6	23.4

Subjects were assigned to each cell or experimental condition as randomly as circumstances would permit. Initially, students from

each school system were randomly assigned to conditions for their grade level. This procedure was followed until almost all of the cells were overfilled. At this point, successive subjects were selected for only those experimental conditions where there was a deficient number. Finally, in order to reduce the overfilled cells to the number of subjects (eight) required by the design, a random selection was made from the available subjects for each cell.

Since many school systems did not have enough students to fill all groups (cells) at all required grade levels, there was confounding of treatments, levels, and schools.

Material. Two literary selections were chosen from literature textbooks. "A Battle over the Teacups" by August Derleth (1957) was chosen as a selection appropriate for use with high school students and "Notch-tail", from a book by Stauffer, Burrows, and Jones (1962), was chosen for use by elementary students. Criteria determining their selection were that they not be available for use by the visually handicapped in any mass produced form, that they be of an appropriate length (around 2000-2100 words), and that their reading ease scores, as determined by Flesch's readability formula (1951), indicate they be of a reading difficulty appropriate for use by the grade levels at which they would be used. Neither of these selections had been published in braille, large type, or on Talking Book previously by the APH, the only mass producer of books used for the education of the blind, and both met other criteria. "A Battle over the Teacups" contained 1970 words and had a reading ease score of 66 which placed it at the eighth and ninth grade level of difficulty. It had a human interest score of 73.4, also determined by a Flesch formula (1951), which classified it as dramatic. The full length "Notch-tail" story was shortened so that the version used contained 2114 words. Its reading ease score was 87 which placed it at the sixth grade level of difficulty and its human interest score of 31.3 classified it as interesting reading.

It would have been desirable to have used a slightly more difficult high school selection; however, it was found that the majority of selections in high school literature fell short of high school difficulty as determined by the Flesch formula. This occurs because difficulty scores reflect both word and sentence length. Literary selections, being nontechnical in nature, usually fall below Flesch's criterion for high school difficulty.

The selections were reproduced in both braille and large type (16-point by APH standards) in booklet form and were recorded on magnetic tape at 3 3/4 inches per second (ips) by a regular male Talking Book reader in the Talking Book studios at the APH. "A Battle over the Teacups" was recorded at approximately 164 words per minute (wpm) and "Notch-tail" at approximately 171 wpm.

Five multiple choice tests of comprehension were constructed for each selection. Both tests were reproduced in braille and large type (16-point) test booklets. Criterion for the tests was that they contain a minimum of 62 items as tests of this length would make possible a wide range in scores and high reliability. The test for "A Battle over the Teacups" contained 70 questions and the test for "Notch-tail" contained 65.

Split-half correlations subsequently were computed using data from the 48 subjects in the one-day reading groups and listening groups. After being corrected by the Spearman-Brown formula, reliabilities were found to be .94 and .91, respectively, for the braille and print versions of "A Battle over the Teacups" and .95 and .92, respectively, for the braille and print versions of "Notch-tail".

Procedure. Scheduling of the treatment groups was determined primarily by what could be most conveniently worked into the school day. As reading groups required more time than listening groups, they had to be scheduled during periods providing for long uninterrupted sessions. Care was taken to vary the time of day the treatment groups were worked from school to school.

Where there was only one subject in a school, as was often the case in public schools, the experimenter worked with him individually. Where there were many, as in the residential schools, the experimenter worked with subjects in groups. Subjects in braille and print groups worked together whenever possible.

On the first day, subjects in the three-day groups were instructed that they would either read or listen to a selection for three consecutive days and that they would be tested on it immediately following their third reading or listening. On the second day, they were told only to read or listen carefully. On the third day, in schools providing many subjects, the one-day reading groups joined the three-day reading groups and the one-day listening groups joined the three-day listening groups. Instructions were reviewed for the benefit of members of the one-day groups and test directions were given. Members of the reading groups were told to raise their hands as they finished reading their selections and they would be given their test on which they were to start work immediately. Members of the listening groups started their tests as a group immediately following the playing of their selection. All students used pencils to mark their answer choices directly in the test booklets. Table 4.3 portrays the scheduling in any school where there were enough subjects to have one or more subjects in each of the treatment groups. In schools where there were fewer than four treatment groups the procedure and instructions were modified to fit the situation.

The initial reading time of each subject was recorded. Each subject was instructed when finished reading to raise his hand at which time the experimenter noted the reading period.

Table 4.3

Literature

Scheduling of Treatment Groups

First Day	Second Day	Third Day
3-day Reading	3-day Reading	3-day Reading 1-day Reading
3-day Listening	3-day Listening	3-day Listening 1-day Listening

Note.--High school and elementary reading groups could be run together; however, their listening groups had to be run separately.

Results

Table 4.4 Summarizes the analysis of the difference between means among the experimental conditions of mode learning, type of reader, amount of practice, and grade level for the high school group. Table 4.5 gives similar information for the elementary group.

Table 4.4

Literature

High School Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Mode (M)	1	748.13	748.13	5.06*
Type (T)	1	131.67	131.67	-
Practice (P)	1	4,651.17	4,651.17	31.48**
Grade Level (GL)	2	149.65	74.82	-
M x T	1	125.13	125.13	-
M x P	1	1.50	1.50	-
M x GL	2	1.26	.63	-
T x P	1	3.80	3.80	-
T x GL	2	80.29	40.14	-
P x GL	2	1,053.41	526.70	3.56*
M x T x P	1	12.51	12.51	-
M x T x GL	2	107.51	53.76	-
M x P x GL	2	22.52	11.26	-
T x P x GL	2	133.40	66.70	-
M x T x P x GL	2	377.62	188.81	1.28
Within Cells	168	24,823.88	147.76	
Total	191	32,423.45		

* Significant at .05 level (3.89 with 1 df and 3.04 with 2 df)
** Significant at .01 level (6.77 with 1 df and 4.72 with 2 df)

Reference to Table 4.4 reveals that of the main effects in the study, only amount of practice and mode of learning were statistically significant, the former at the .01 level of significance and the latter at the .05 level. As might be expected, the three-day groups learned more than the one-day groups. For the high school group, reading resulted in more learning than listening. No differences in amount learned were found between braille and print students nor between students at different grades within the high school. However, an interaction, significant at the .05 level, was found between grade levels and practice which indicated that students in the higher grades learned more with additional practice.

Table 4.5

Literature

Elementary School Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Mode (M)	1	.62	.62	-
Type (T)	1	399.62	399.62	-
Practice (P)	1	3,242.29	3,242.29	19.93**
Grade Level (GL)	2	3,644.88	1,822.44	11.20**
M x T	1	29.31	29.31	-
M x P	1	399.64	399.64	-
M x GL	2	70.46	35.23	-
T x P	1	245.27	245.27	-
T x GL	2	103.58	51.79	-
P x GL	2	320.85	160.42	-
M x T x P	1	490.87	490.87	-
M x T x GL	2	241.58	120.79	-
M x P x GL	2	327.69	163.84	-
T x P x GL	2	62.56	31.28	-
M x T x P x GL	2	169.14	84.57	-
Within Cells	168	27,332.38	162.69	
Total	191	37,080.74		

* Significant at .05 level (3.89 with 1 df and 3.04 with 2 df)
** Significant at .01 level (6.77 with 1 df and 4.72 with 2 df)

In the elementary group both amount of practice and grade level were found to be significantly related to amount learned. Additional practice provided for additional learning and students in the higher elementary grades learned more than those in the lower elementary grades. Both of these differences were significant at the .01 level.

No differences in amount learned were found between braille and print students nor were there any differences in the amount learned by reading or listening in the elementary group.

Table 4.6 presents the means and standard deviations for the 24 cells included in each of the two analyses of variance. From this table it can be seen that learning occurred in all groups as the mean scores are all well above chance which would have been 14 and 13 for the high school and elementary selections respectively.

Table 4.6

Literature

Means and Standard Deviations of Correct Scores on Tests Made by Each Subgroup (N=8)

	High School Group					
	$\bar{x}_9$	σ	$\bar{x}_{10}$	σ	$\bar{x}_{11}$	σ
Braille						
1-day Reading	43.12	15.93	42.88	16.54	48.25	12.30
3-day Reading	57.25	6.04	57.00	7.13	50.75	16.52
1-day Listening	41.88	13.82	35.12	10.58	42.62	10.85
3-day Listening	44.88	15.50	52.12	6.60	49.25	9.05
Print						
1-day Reading	43.38	13.63	38.00	10.39	43.75	13.17
3-day Reading	44.62	15.70	55.88	5.36	54.00	7.84
1-day Listening	38.75	11.40	37.38	12.68	41.00	15.20
3-day Listening	46.62	9.13	54.25	8.41	47.62	15.53
	Elementary School Group					
	$\bar{x}_4$	σ	$\bar{x}_5$	σ	$\bar{x}_6$	σ
Braille						
1-day Reading	27.88	13.81	39.38	15.72	45.12	9.76
3-day Reading	41.00	16.17	51.38	8.94	52.38	8.81
1-day Listening	30.12	12.35	37.62	14.64	42.88	14.83
3-day Listening	43.62	9.68	46.12	9.93	51.38	10.95
Print						
1-day Reading	31.50	15.31	38.00	12.08	48.25	10.14
3-day Reading	38.38	14.59	38.12	17.61	40.88	14.40
1-day Listening	27.62	11.88	39.88	10.82	34.06	9.04
3-day Listening	41.62	15.68	44.75	13.34	51.25	8.75

Observation of the data showed that all three-day groups (combined levels) learned more than their similar one-day groups except for the elementary print group that read for three days. This group actually learned less than did the elementary print group that read for one day. This lack of additional learning occurred in all three of the grades comprising the level. However, in all probability it only means that the sample used was atypical.

Scores ranged from 17-67 on the test for "A Battle over the Teacups" and from 10-63 on the "Notch-tail" test. Seventy was the

maximum possible score on the former and 65 on the latter. Scores on the test for the high school selection were slightly negatively skewed while those on the elementary selection were very slightly negatively skewed as can be seen from their quartile points as presented in Table 4.7. Both median scores are greater than the middle of their respective ranges.

Table 4.7

Literature

Quartile Points for Tests Used to Measure Comprehension

	"A Battle over the Teacups"	"Notch-tail"
Q_3	56.6	53.2
Q_2	49.3	42.5
Q_1	38.0	30.2

Efficiency of learning was computed from data accumulated on the one-day practice groups. Levels were combined for both types of readers (braille and print). First, the average comprehension scores of one-day reading and one-day listening groups were divided by the average times spent, respectively, reading and listening to the selection. This yielded ratios of the amount of learning per unit of time for each group. A second ratio was then computed of the amount of learning per unit of time for the reading groups to that for the listening groups which proved to be a more efficient way to learn literature than reading as is shown in Table 4.8.

Table 4.8

Literature

Relatively Efficiency of Learning by Reading or Listening

Group	Learning per Unit of Time Reading	Listening	Listening to Reading Efficiency
High School Braille	1.8081	3.3095	183%
High School Print	1.5616	3.2398	207%
Elementary Braille	.9346	2.9862	320%
Elementary Print	1.2852	2.7393	213%

The finding that listening to reading efficiency was considerably higher for the elementary braille group than for any of the other groups can be understood when the extremely slow reading rate for this group is considered.

Product-moment coefficients of correlation were computed between comprehension and reading time from data on all subjects in the one-day reading groups. Data from three-day reading groups were not included as these comprehension scores would reflect a practice effect. The correlations found are reported in Table 4.9. None of the relationships are significantly different from zero.

Table 4.9

Literature

Coefficients of Correlation between Reading Time and Amount Learned by One-Day Reading Groups

Group	N[a]	r[b]
High School Braille	27	-.14
High School Print	27	-.01
Elementary Braille	33	-.08
Elementary Print	26	-.33

a Based on data for all students tested
b None significant at the .05 level

Average reading rates were computed from data on all subjects who read. Reading time for each was determined by the amount of time required for him to complete reading his selection the first time. Average reading rates, their standard deviations, and the ranges of rates found are presented in Table 4.10 in terms of wpm. The reading rates reported should represent realistic study rates as subjects were reading under instructions to read carefully as they would be tested on what they had read.

Table 4.10

Literature

Average Reading Rates, Standard Deviations, and Ranges

	N	$\bar{x}$ wpm Read	σ in wpm	wpm Range
High School Braille	60	74	37	20-241
High School Print	57	81	56	16-314
Elementary Braille	76	58	29	20-155
Elementary Print	56	75	37	29-187

When mean reading rates are compared with median reading rates, it becomes obvious that the means are depressed because of a few extremely slow readers. Table 4.11 presents mean and median reading

rates for six grade levels. Each was computed from an N of 16 representing the eight one-day readers and the eight three-day readers used in their respective analyses of variance. In all cases, most particularly at the high school level, group median reading rates are faster than group mean reading rates.

Table 4.11

Literature

Mean and Median WPM Reading Rates by Grade and Type of Reader

		4th	5th	6th	Elem. Group	9th	10th	11th	H. S. Group
Braille	Mean	50	66	67	60	76	81	65	74
	Median	46	72	69	67	96	90	74	89
Print	Mean	67	74	81	74	75	68	103	80
	Median	81	73	94	83	77	79	106	94

The group means presented in Table 4.11 vary only slightly from those presented in Table 4.10 which were computed from larger samples.

Results of the literature part of the research will be discussed more fully with results found for the science and social studies parts.

Science

Data comparing the amount of scientific information learned by visually handicapped students by means of reading and listening were collected and analyzed in essentially the same way as those data for literary material. Scientific data were collected during the 1965-1966 school year simultaneously with data for social studies.

Method

Subjects. All students in the two studies of the learning of scientific material were legally blind. As with literature, braille students participating were required to have read braille for a minimum of one year. Subjects were from public school systems at Berkeley, Oakland, and San Francisco, California; Pinellas County, Florida; Indianapolis, Indiana; and Louisville, Kentucky. Residential schools providing subjects were Arizona, Arkansas, California, Kentucky, Maryland, New Mexico, Oregon, Virginia, and Washington. Only one of the students represented in the major analyses of the science part had previously taken part in the study of literature. Table 4.12 shows the percent of braille and print readers used in the major analyses of the two studies of science coming from public and residential schools.

Table 4.12

Science

Percent of Braille and Print Readers from Residential and Public Schools in Elementary and High School Groups

	High School		Elementary		Total	
	Residential	Public	Residential	Public	Residential	Public
Braille	84.4	15.6	90.6	9.4	87.5	12.5
Print	75.0	25.0	80.2	19.8	77.6	22.4

Subjects were assigned to the various experimental conditions as were those in the research concerning literature.

Material. Two scientific selections were chosen for use that dealt with oceanography. These were chosen by the same criteria described for literature. The topic was selected as it was one about which blind students had little opportunity to learn in their regular school curriculum as the topic is hardly mentioned in any mass produced braille, large type, or Talking Book textbook. The selections used for high school and elementary students, respectively, were "The Land beneath the Sea" (Arnou, 1962) and "The Gulf Stream" (Malkus, 1956). "The Land beneath the Sea" contained 2071 words, had a reading ease score of 59 which classified it as of tenth to twelfth grade difficulty, and had a human interest rating of 2.7, dull, which is typical for technical or scientific writing. "The Gulf Stream" contained 2102 words, had a reading ease score of 76 which place it at the seventh grade level of difficulty, and was also classified as dull having a human interest rating of 8.0. Reading ease and human interest scores for both selections were computed by the Flesch formulas (1951). Only after an exhaustive search for appropriate materials was the elementary selection made. It had been planned to use material rated at the fifth grade level of difficulty for this group, however, this proved unfeasible in terms of the other criteria.

The selections were reproduced in booklet form in both braille and large type (18-point by APH standards) and in recorded form on magnetic tape at 3 3/4 ips. The recordings were made in the Talking Book studios at the APH by the same professional male Talking Book reader who recorded the literary selections used. "The Land beneath the Sea" was recorded at approximately 153 wpm and "The Gulf Stream" at approximately 164 wpm.

As with the literary selections, five choice multiple choice tests of comprehension were constructed for each selection. These tests were reproduced in booklet form in both braille and large type (18-point). The tests for "The Land beneath the Sea" and "The Gulf Stream" contained 74 and 72 questions respectively.

Reliabilities for the tests were subsequently computed from data on the one-day groups as were those for the literature tests. These

were found to be .87 and .93, respectively, for the braille and print versions of "The Land beneath the Sea" and .90 and .76, respectively, for the two versions of "The Gulf Stream". Reliabilities were computed from Ns ranging from 44-47. All groups contained 48 subjects, however, in instances where a subject had not completed his test or had skipped any part of it, his score was prorated. (No test score was prorated if the subject had not completed half of the test.) Although legitimate and useful for most purposes, such tests could not be used in computing the split-half reliability of the test.

Procedure. The procedure used to gain information on learning science through reading or listening was practically identical to that used and described for literature. Data were collected for social studies material simultaneously with science material so that often subjects studying both types of subject matter worked together in the reading groups.

As data were collected for the two subject matters simultaneously, scheduling of the treatment groups was more complex than for literature. Most of the subjects used in the science part also participated in the social studies part. Each subject was assigned to one of the four science treatment groups as previously described. Then those who were assigned to a science one-day reading group were assigned to a social studies three-day listening group; those assigned to a science three-day reading group were assigned to a social studies one-day listening group; those assigned to a science one-day listening group were assigned to a social studies three-day reading group; and those assigned to a science three-day listening group were assigned to a social studies one-day reading group. This arrangement provided for double use of each subject while involving him for only four days, three of which had to be consecutive. Scheduling of the high school and elementary groups in the residential schools was varied systematically through four different schedules so that no one group was regularly seen at any one time and so that the type of material, mode of presentation, and treatment groups initially worked with would vary. In public schools scheduling was primarily determined by convenience.

Results

Science data were analyzed in the same manner as were literature data. Results will be reported in parallel form.

Tables 4.13 and 4.14 summarize the analyses of the differences between means among the experimental conditions of mode of learning, type of reader, amount of practice, and grade level for the high school and elementary groups respectively.

Table 4.13 shows that, for the high school group, practice and type were the only main effects under study having a significant effect on learning, the former at the .01 level and the latter at the .05 level of significance. More was learned by three-day groups than by one-day groups, as might be expected, and more was learned by braille groups than by print groups. No significant differences were found between the amount of learning resulting from reading or listening nor were there any differences found in the amount learned by students at different grade levels.

Table 4.13

Science

High School Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Mode (M)	1	333.38	333.38	-
Type (T)	1	1,116.50	1,116.50	6.63*
Practice (P)	1	1,286.50	1,286.50	7.64**
Grade Level (GL)	2	46.44	23.22	-
M x T	1	417.13	417.13	-
M x P	1	94.92	94.92	-
M x GL	2	259.39	129.70	-
T x P	1	138.39	138.39	-
T x GL	2	69.77	34.88	-
P x GL	2	755.02	377.51	-
M x T x P	1	121.92	121.92	-
M x T x GL	2	267.82	133.91	-
M x P x GL	2	67.15	33.58	-
T x P x GL	2	60.43	30.22	-
M x T x P x GL	2	39.98	19.99	-
Within Cells	168	28,304.88	168.48	
Total	191	33,379.62		

* Significant at .05 level (3.89 with 1 df and 3.04 with 2 df)
** Significant at .01 level (6.77 with 1 df and 4.72 with 2 df)

Reference to Table 4.14 reveals that differences in the amount learned, significant at the .01 level, occurred within three of the main effects being tested in the elementary group. These were type, practice, and grade level with significantly more being learned by braille groups than print groups, by three-day groups than one-day groups, and by students at higher elementary levels than at lower elementary levels. No difference in the amount learned resulted from reading or listening.

An interaction was found between practice and grade level that was significant at the .01 level of confidence. Here it was found that students in the higher elementary grades learned more from additional practice than those at lower levels.

Table 4.14

Science

Elementary School Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Mode (M)	1	212.52	212.52	-
Type (T)	1	981.02	981.02	9.29**
Practice (P)	1	1,507.52	1,507.52	14.27**
Grade Level (GL)	2	3,566.07	1,783.03	16.88**
M x T	1	.52	.52	-
M x P	1	.52	.52	-
M x GL	2	49.51	24.75	-
T x P	1	2.52	2.52	-
T x GL	2	20.45	10.22	-
P x GL	2	1,076.64	538.32	5.10**
M x T x P	1	9.19	9.19	-
M x T x GL	2	39.14	19.57	-
M x P x GL	2	233.45	116.72	-
T x P x GL	2	359.63	179.81	-
M x T x P x GL	2	93.03	46.52	-
Within Cells	168	17,744.75	105.62	
Total	191	25,896.48		

* Significant at .05 level (3.89 with 1 df and 3.04 with 2 df)
** Significant at .01 level (6.77 with 1 df and 4.72 with 2 df)

Means and standard deviations for the 24 cells included in each of the two analyses of variance are presented in Table 4.15. A chance score on the high school test would have been 15. As can be seen, considerable learning occurred in all groups. For the elementary test, a chance score would have been 14. Here it is apparent that little learning occurred in several of the fourth grade print groups. Although the selection used was difficult for this level it is interesting to note that the fourth grade braille groups learned considerably more from it than the print groups.

Table 4.15

Science

Means and Standard Deviations of Correct Scores on Tests Made by Each Subgroup (N=8)

	High School Group					
	9		10		11 & 12	
Braille	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
1-day Reading	41.00	12.39	42.12	7.77	36.75	8.05
3-day Reading	35.38	15.31	47.88	14.36	46.50	16.51
1-day Listening	42.38	16.52	37.88	11.81	40.00	9.68
3-day Listening	42.75	8.83	39.62	15.25	48.88	13.79
Print						
1-day Reading	36.62	17.10	35.25	13.50	32.50	8.60
3-day Reading	43.12	13.64	43.75	13.42	47.12	10.67
1-day Listening	33.75	8.01	32.88	17.05	30.00	10.24
3-day Listening	35.12	9.95	35.12	11.78	38.00	17.66

	Elementary School Group					
	4		5		6	
Braille	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
1-day Reading	24.62	10.72	24.50	7.62	31.12	10.16
3-day Reading	26.75	15.98	27.75	13.85	40.25	12.43
1-day Listening	19.12	6.60	26.12	11.62	26.75	12.89
3-day Listening	26.50	9.21	26.25	11.89	37.00	18.63
Print						
1-day Reading	23.62	6.44	20.00	6.44	20.75	6.04
3-day Reading	17.38	8.12	25.88	9.22	39.62	9.59
1-day Listening	16.50	4.21	19.00	4.34	23.88	8.25
3-day Listening	17.75	3.37	23.88	11.46	34.25	11.37

Scores ranged from 10-68 out of a possible 74 on the high school science selection, "The Land beneath the Sea", and from 6-65 out of a possible 72 on the elementary science selcetion, "The Gulf Stream". Table 4.16 shows the quartile distribution of scores on the former to be slightly negatively skewed while the distribution of scores on the latter was slightly positively skewed. The median score on the high school test was found to lie midway in the range of scores while the median score earned by the elementary groups was considerably below the middle of the range of scores.

Table 4.16

Science

Quartile Points for Tests Used to Measure Comprehension

	"The Land beneath the Sea"	"The Gulf Stream"
Q_3	48.7	32.1
Q_2	39.5	22.9
Q_1	28.2	17.1

Efficiency of learning was computed for science in the same way as for literature and, just as with literature, listening proved to be the more efficient way to learn in every instance. Listening to reading efficiency percentages for scientific material are presented in Table 4.17.

Table 4.17

Science

Relative Efficiency of Learning by Reading or Listening

Group	Learning per Unit of Time Reading	Learning per Unit of Time Listening	Listening to Reading Efficiency
High School Braille	1.1914	2.9536	248%
High School Print	1.2428	2.3736	191%
Elementary Braille	.6585	1.8677	284%
Elementary Print	.8086	1.5401	190%

Correlations, computed to determine the relationship between reading speed and comprehension, are reported in Table 4.18. These were computed from data on all subjects participating in one-day reading groups including the extras who were randomly omitted from groups used for the analyses of variance.

Moderate relationships were found in both high school and elementary groups of print readers of science. Interestingly enough, the two relationships are in opposite directions; the high school group's faster readers tending to earn higher comprehension scores and the elementary group's slower readers tending to earn higher comprehension scores.

Table 4.18

Science

Coefficients of Correlation between Reading Time and Amount Learned by One-Day Reading Groups

Group	N[a]	r
High School Braille	29	-.00
High School Print	25	-.41*
Elementary Braille	34	.21
Elementary Print	30	.50**

a Based on data for all students tested
* Significant at .05 level
** Significant at .01 level

Reading rates for scientific material are presented in Table 4.19 along with their standard deviations and the ranges of rates found. These were computed from initial reading times of all subjects including those not used in the analyses of variance. As with literature, students were reading at what should have been normal study rates having been instructed to read carefully as they would be tested on what they had read.

Table 4.19

Science

Average Reading Rates, Standard Deviations, and Ranges

	N	$\bar{x}$ wpm Read	σ in wpm	wpm Range
High School Braille	61	65	33	20-197
High School Print	58	84	35	37-259
Elementary Braille	64	53	26	20-173
Elementary Print	57	69	26	30-187

The pattern of reading rates found is similar to that reported for literature, the greatest aberrance appearing in the high school braille group whose reading rates were nine wpm slower for science than for literature.

Table 4.20 reports mean and median reading rates, by grade. The grade reading rates were each determined from an N of 16 having been computed from data on subjects used in the analyses of variance groups. The median rates are consistently more rapid than are the mean rates indicating that the means were depressed by a few

extremely slow readers. For this reason, as well as the fact that the rates were computed from small samples, both mean and median rates are being reported.

Table 4.20

Science

Mean and Median WPM Reading Rates by Grade and Type of Reader

		4th	5th	6th	Elem. Group	9th	10th	11th 12th	H. S. Group
Braille	Mean	44	45	65	50	69	58	68	65
	Median	46	49	64	56	69	74	80	73
Print	Mean	75	69	69	71	77	87	82	82
	Median	76	72	81	76	99	99	92	96

Means computed on total groups and their comparable analyses of variance groups vary no more than three wpm.

These results will be discussed more fully at the end of the chapter with results found for the other two subject matters under study.

Social Studies

Data comparing the amount of social studies information learned by visually handicapped students by means of reading and listening were collected during the 1965-1966 school year simultaneously with similar data for scientific material.

Method

Subjects. Subjects used in the two studies of social studies were from the same school systems as were those used in the studies of scientific material. Many of the same subjects participated in both parts. All were legally blind and all were at the grade levels required by the experimental design. Braille students were required to have read braille for a minimum of one year. Only two subjects used in the major analyses of social studies learning had been included in the study of literature. Table 4.21 reports the percent of braille and print readers coming from public and residential schools who were used in the major analyses of social studies.

Table 4.21

Social Studies

Percent of Braille and Print Readers from Residential and Public Schools in Elementary and High School Groups

	High School		Elementary		Total	
	Residential	Public	Residential	Public	Residential	Public
Braille	85.4	14.6	91.7	8.3	88.5	11.5
Print	81.2	18.8	81.2	18.8	81.2	18.8

There are two reasons accounting for the slight difference in subjects taking part in the science and social studies parts of the research. First, because of natural absence there were a number of subjects who participated in only one part of the study. Second, extra subjects were randomly omitted from overfilled cells in each study. Those discarded from the major analyses of scientific material were not necessarily discarded from the major analyses of the social studies material.

Material. The two social studies selections used were historical in content. They were chosen for use using the same criteria as were the literature and science selections. The high school selection, entitled "Franklin Pierce" (Morgan, 1959), was a 2043 word biographical sketch of the little known fourteenth President of the United States. The selection had a reading ease score of 54 which placed it at the tenth to twelfth grade level of difficulty and a human interest score of 31.4 which classified it as interesting reading. The elementary selection used was a 2070 word selection with the self descriptive title "History of Bread" (Buehr, 1959). This selection had a reading ease score of 79 which placed it on the lower limit of seventh grade difficulty and a human interest score of 16.7 which classified it as mildly interesting. Reading ease and human interest scores for both selections were computed by the Flesch formulas (1951).

As with science, it had been hoped that an elementary social studies selection having a fifth grade reading difficulty level might be found and used. However, in terms of the other criteria, this proved unfeasible.

The selections were reproduced in booklet form in braille and large type (18-point by APH standards) and were recorded on magnetic tape at 3 3/4 ips by a regular male Talking Book reader in the Talking Book studios at the APH. "Franklin Pierce" was recorded at approximately 156 wpm and "History of Bread" at approximately 165 wpm.

Five choice multiple choice tests of comprehension were constructed using the same criterion as for the tests constructed for literature and science selections. These tests were reproduced in booklet form in braille and large type (18-point). The test for "Franklin Pierce" contained 77 questions and the test for "History of Bread" contained 63 questions.

Split-half correlations subsequently were computed using data from subjects in the one-day reading and listening groups. After being corrected by the Spearman-Brown formula the reliabilities for the braille and print versions were found to be .91 and .92, respectively, for "Franklin Pierce" and .96 and .93, respectively, for "History of Bread". Reliabilities were computed from Ns ranging from 46-48. All groups contained 48 subjects; but, as with science tests, not all tests could be used in the computation of the split-half reliabilities.

Procedure. The procedure used to acquire information on social studies material was described with the procedure for scientific material as data for the two subject matters were collected simultaneously. The actual procedure for both was practically identical to that described in detail for literature.

Results

Social studies data were analyzed in the same way as were data for literature and science and will be reported in parallel form.

Results of the analyses of the difference between means among the experimental conditions are reported in Tables 4.22 and 4.23 for high school and elementary groups respectively.

Table 4.22

Social Studies

High School Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Mode (M)	1	1,116.51	1,116.51	5.53*
Type (T)	1	1,524.38	1,524.38	7.55**
Practice (P)	1	1,479.63	1,479.63	7.33**
Grade Level (GL)	2	426.45	213.22	-
M x T	1	106.50	106.50	-
M x P	1	312.63	312.63	-
M x GL	2	32.00	16.00	-
T x P	1	141.80	141.80	-
T x GL	2	22.88	11.44	-
P x GL	2	240.13	120.06	-
M x T x P	1	7.92	7.92	-
M x T x GL	2	341.53	170.76	-
M x P x GL	2	2.58	1.29	-
T x P x GL	2	11.91	5.96	-
M x T x P x GL	2	537.77	268.88	-
Within Cells	168	33,922.38	201.91	
Total	191	40,227.00		

* Significant at .05 level (3.89 with 1 df and 3.04 with 2 df)
** Significant at .01 level (6.77 with 1 df and 4.72 with 2 df)

Table 4.23

Social Studies

Elementary School Analysis of Variance Summary

Source of Variation	df	Sums of Squares	Mean Squares	F
Mode (M)	1	120.34	120.34	-
Type (T)	1	1,291.69	1,291.69	10.24**
Practice (P)	1	1,190.02	1,190.02	9.43**
Grade Level (GL)	2	6,118.95	3,059.48	24.25**
M x T	1	475.01	475.01	-
M x P	1	35.02	35.02	-
M x GL	2	304.82	152.41	-
T x P	1	44.09	44.09	-
T x GL	2	55.22	27.61	-
P x GL	2	90.83	45.42	-
M x T x P	1	.75	.75	-
M x T x GL	2	43.27	21.64	-
M x P x GL	2	53.82	26.91	-
T x P x GL	2	313.00	156.50	-
M x T x P x GL	2	113.34	56.67	-
Within Cells	168	21,197.75	126.18	
Total	191	31,447.92		

* Significant at .05 level (3.89 with 1 df and 3.04 with 2 df)
** Significant at .01 level (6.77 with 1 df and 4.72 with 2 df)

Of the main effects under study in the high school group, type of reader, amount of practice, and mode of learning were all statistically significant, type and practice differences being significant at the .01 level and mode differences being significant at the .05 level. Braille readers learned more than print and, as expected learning increased with additional practice. Reading proved to be the mode of greater learning of social studies in the high school group. No differences in amount learned were found between the high school grade levels.

Differences, significant at the .01 level of confidence, were found for three of the four main effects under study in the elementary group. These were type of reader, with braille readers learning more; amount of practice, with three-day groups learning more than one-day groups; and grade level with more being learned by students at higher grade levels than by those at lower grade levels. No differences in learning due to the mode of study were found in this group.

Table 2.24 reports means and standard deviations for the 24 cells included in each of the two analyses of variance. With the

exception of the two one-day fourth grade print groups, all mean scores are well above chance which would have been scores of 15 and 13, respectively, for the high school and elementary tests. As with the science results, it was interesting to find that fourth grade braille students were better able to learn the material than were fourth grade print students.

Table 4.24

Social Studies

Means and Standard Deviations of Correct Scores on Tests Made by Each Subgroup (N=8)

	High School Group					
	9		10		11 & 12	
Braille	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
1-day Reading	46.88	11.57	42.38	12.86	54.00	14.72
3-day Reading	53.25	20.06	54.88	10.29	55.50	16.62
1-day Listening	46.62	16.10	51.62	11.96	47.88	14.35
3-day Listening	47.38	12.13	48.12	16.37	49.25	17.70
Print						
1-day Reading	39.00	9.55	44.50	13.85	43.38	14.52
3-day Reading	53.25	12.62	50.25	17.04	51.62	14.15
1-day Listening	36.50	13.04	33.38	7.05	44.50	12.86
3-day Listening	42.62	17.83	43.62	13.33	43.50	13.61
	Elementary School Group					
Braille						
1-day Reading	21.00	8.60	21.12	7.94	38.62	15.67
3-day Reading	27.00	10.18	33.00	6.99	40.75	14.37
1-day Listening	29.12	11.13	31.00	15.16	37.00	15.11
3-day Listening	29.38	14.90	40.05	11.35	42.88	10.51
Print						
1-day Reading	17.88	7.08	24.62	11.48	34.62	10.29
3-day Reading	24.00	6.82	30.12	13.10	38.00	18.05
1-day Listening	15.12	2.23	28.12	6.36	32.12	9.92
3-day Listening	23.62	10.91	27.38	7.58	33.50	9.56

The range of scores on the high school social studies selection, entitled "Franklin Pierce", was from 13-75 out of a possible 77. The range on the elementary social studies selection, "History of Bread", was from 9-57 out of a possible 63. Quartile distributions are shown in Table 4.25. The distribution of scores on "Franklin Pierce" was normal and for "History of Bread" slightly positively skewed. The median score on the "Franklin Pierce" test was found to be close to the middle of the range of scores while the median

score on the "History of Bread" test was below the midpoint of its range of scores.

Table 4.25

Social Studies

Quartile Points for Tests Used to Measure Comprehension

	"Franklin Pierce"	"History of Bread"
Q_3	57.5	39.3
Q_2	46.5	27.5
Q_1	35.0	19.5

Table 4.26 reports listening to reading efficiency percentages. These were computed as were those for literature and science and just as with the other two types of subject matter under study, listening proved to be the most efficient way to learn in every case.

Table 4.26

Social Studies

Relative Efficiency of Learning by Reading or Listening

Group	Learning per Unit of Time Reading	Learning per Unit of Time Listening	Listening to Reading Efficiency
High School Braille	1.5895	3.6113	227%
High School Print	1.8829	2.9055	154%
Elementary Braille	.7171	2.5842	360%
Elementary Print	.7882	2.0048	254%

Correlations were computed to determine the relationship between reading speed and comprehension. These are reported in Table 4.27. None of the relationships found are significantly different from zero. These were computed from all subjects in the one-day reading groups including those not used in the analyses of variance.

Table 4.27

Social Studies

Coefficients of Correlation between Reading Time and Amount Learned by One-Day Reading Groups

Group	N[a]	r[b]
High School Braille	26	.15
High School Print	31	-.15
Elementary Braille	35	-.14
Elementary Print	31	-.16

a Based on data for all students tested
b None significant at the .05 level

Average reading rates for all subjects who read are presented in Table 4.28 along with their standard deviations and the ranges of rates found. These were determined as were those for the other two subject matters. The pattern of rates found is almost identical to that found for literary material.

Table 4.28

Social Studies

Average Reading Rates, Standard Deviations, and Ranges

Group	N	$\bar{x}$ wpm Read	σ in wpm	wpm Range
High School Braille	53	74	35	25-163
High School Print	59	83	31	39-266
Elementary Braille	68	53	21	23-127
Elementary Print	62	71	25	32-136

Table 4.29 reports mean and median reading rates by grade. These were each computed from an N of 16 which was made up of the eight one-day and eight three-day readers at each level used in their respective analyses of variance. The median rates are faster than are the mean rates which vary no more than three wpm from those mean rates computed on larger groups reported in Table 4.28. As with literature and science, it appears that mean rates were depressed as a result of a few exceedingly slow readers.

Table 4.29

Social Studies

Mean and Median WPM Reading Rates by Grade and Type of Reader

	4th	5th	6th	Elem. Group	9th	10th	11th-12th	H. S. Group
Mean	55	44	57	51	67	78	78	74
Median	56	49	59	55	79	85	91	88
Mean	61	72	77	69	80	93	87	86
Median	67	81	88	78	85	100	100	96

These findings will be discussed in the section to follow.

Discussion

There are four particularly interesting features to the findings concerning reading rates. First, the high school braille reading rates of 65-74 wpm is considerably slower than the 86 wpm reported in previous research (Ethington, 1956) while the elementary braille reading rate of around 55 wpm is in line with previous findings (Lowenfeld, 1945). It is possible that the difference found for the braille high school groups' reading rates may reflect a difference in difficulty of the selections used. However, even though the literature selection used in this research was less difficult than the science and social studies selections, no differences were found between the rates at which literature and social studies were read. The science selection, which was of the same difficulty as the social studies selection, was read more slowly. Second, the high school print groups' reading rate of about 83 wpm was little faster than the high school braille reading rates found which lends credence to informal observations that legally blind readers of print read little faster than do braille readers. Third, the high school print group read only about 10 wpm faster than the elementary print group. And fourth, the large standard deviations and wide ranges in reading rate found attest to an inordinate difference in individual reading rates in all groups.

Apparently the problem of slow reading rates is of even greater magnitude for the visually handicapped than previously realized. Instead of braille high school students requiring about three times as long to read an assignment as their sighted peers, as previously believed, it takes them about four times as long. The educational handicap resulting is one that grows as a student progresses through the grades and encounters increasingly greater reading assignments.

No differences were found in the amount learned by reading or listening in elementary groups for any of the subject matters under

study nor in the high school group studying science. However, in the high school groups studying literature and social studies differences in learning were found, significant at the .05 level, favoring reading. Although these differences were found, they are of little practical value when considered in relation to the findings in all six studies, all significant at the .01 level, that learning was increased with additional practice. From an educational point of view, a student could listen to material twice in the same amount of time it would require for him to read it once.

Listening was proven to be the more efficient way to learn subject matter of the three types used in this research by all types of legally blind students. Efficiency percentages favoring braille ranged from 284-360% for elementary braille groups; from 190-254% for elementary print groups; from 183-248% for high school braille groups; and from 154-207% for high school print groups. Findings of these magnitudes leave little room for doubt.

No differences in learning were found that could be attributed to an interaction between mode and practice. This means that additional learning occurring as a result of additional practice by reading and listening is of equal amounts.

A problem in using recorded material for study purposes is that the listener is in a passive role. Because of this his attention is apt to stray. The six selections used in the research being reported here were all short and, therefore, this did not appear to be a problem. However, as previously reported in Chapter III, it was repeatedly mentioned as a problem by those students interviewed who customarily studied from recorded textbooks. It was suggested that the active engagement of taking notes was the best means to focus attention. Some felt it was necessary to take more notes when studying from recordings than when studying from braille or print books. If this is true, it would mean that proportionally more time would be required for note taking when studying from recorded material than from embossed or printed material.

Differences were found between the amount learned by braille and print students in four of the six studies. Each time braille students learned more. What this may mean is that the print samples used were not as representative of the print reading population as were the braille samples. This could have occurred because most of the subjects came from residential school populations where there is a preponderance of braille students. The majority of print students are enrolled in public schools and it is possible that a disproportionate number of the ones enrolled in residential schools are there because of their having educational problems.

In the elementary groups studying all three types of subject matter grade level differences were found. In each case more was learned by students in the higher elementary grades than in the lower. Although such a trend would be expected, as all learning is based on previous learning, it may have been partially caused by the fact that the selections used were a little difficult for the group, particularly the lower levels of the group. The literature selection used had a sixth grade reading difficulty and the science and social studies selections were of a seventh grade reading

level. Even so, learning was exhibited by all groups, however, as previously mentioned, several of the fourth grade print groups did not learn much.

The results of the research reported in this chapter indicate that educators should make greater use of recorded material in the education of the visually handicapped in an effort to decrease the educational handicap caused by their slow rate of reading.

Chapter V

Conclusions and Directions for Future Research

Conclusions

1. When all factors are taken into account, listening appears at least the equal of reading in learning materials when presented under the conditions of this experiment. Although absolute results at the high school level favored reading in two subject areas, the time differentials required for learning using the two modes appear to tip the balance in favor of listening. These findings apply equally to large type readers and braille readers.

2. Listening can be an extremely passive behavior. Descriptions given by some of the subjects interviewed and observation of listening subjects in the six learning studies lead to this conclusion. Results reported in Chapter III indicate that active listeners are better listeners. Therefore, increase in interaction between the listener and his material seems important. Such interaction might well shift results in favor of listening.

3. Blind students' listening ability may be slightly superior to sighted students' as measured by the STEP Listening Test. Generally speaking, the same types of relationships among measures of listening, academic achievement, IQ, and personal adjustment characterize the blind as they characterize the sighted.

4. For two of the three groups tested, the STEP Listening Test appeared to adequately discriminate among the blind. However, for blind Negro students enrolled in a segregated residential school, the discriminating power of the test was greatly reduced.

5. Blind Negro students enrolled in a segregated residential school scored quite low on the STEP Listening Test. The means of seven of the nine grades tested fall within the lower quartile of the test norms. These findings imply that cultural and environmental forces may be significant in development of listening skills. Attempts to emphasize listening as a vehicle for overcoming educational deficits of culturally and environmentally deprived groups may, therefore, be doomed to failure.

6. The equipments, materials, and techniques utilized in study by blind students have many areas of incompatibility. This doubtlessly reduces the effectiveness of use of recordings in learning. A systems development approach is needed in working with this problem in order to coordinate design of display systems, response systems, and techniques for their use in terms of the overall study problem.

Directions for Future Research

1. Learning by listening should be studied with listening word rates faster than those utilized in the studies reported here. Studies of this type using word rates up to 275 wpm will be conducted under this project during the Spring of 1967. They will replicate, in part, the studies already described.

2. Future learning studies, wherever possible, should be designed so that subjects participate more actively in the listening process.

3. A thorough analysis should be made of the tasks involved in learning when using recorded texts. A superficial analysis of this kind can be made from the information in Chapter III. It is hoped to complete a more formal task analysis by August 1967 under this current project.

4. Using the information developed in the task analysis, a coordinated system for study using recorded texts should be developed. Coordinated within the system should be designs for playback equipment, recorded textbook format, response equipment, and user techniques.

5. When this system is developed, students should be trained in its use and relative learning through listening and reading again be evaluated.

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Appendix

Recorded Textbook Interview Form - 1965

Name _____ Grade Last Sem. _____ Braille___ Print___

School _____ City _____

Use: What recorded texts did you use last year?

Subject _____ Book _____ Tape or Disc

Subject _____ Book _____ Tape or Disc

Subject _____ Book _____ Tape or Disc

How long have you been using recorded texts?

What equipment is necessary to study?

Anything else?

_____ phonograph

_____ recorder

_____ second tape recorder

_____ loud speaker

_____ earphones

_____ brailler

Where do you use recorded texts?

Describe the place where you study. Probe.

environmental noise

distractions

earphones

Has anyone taught you how to study using recordings?

How do you study daily using recorded texts for (each subject named above)?

Recorded Textbook Interview Form - 1965

Name_____ School_____

Do you plan your study (massed vs distributed practice)?

How long do you listen at a time?

Do you take notes?

How? Describe exactly.

For what do you use your notes?

How many times do you listen?

How do you review for a test?

Do you get sleepy while listening to recorded material?

What do you do about it?

How do you deal with maps, graphs, and charts?

What do you do when strange words occur?

How do you learn to spell new words?

Do your recorded books have a table of contents?

How is it arranged?

How do you use it?

How do you find your place?

Discs

Tapes

Does study with recordings differ from study with books?

Recorded Textbook Interview Form - 1965

Name_____ School_____

Which do you prefer for what?

Why?

Do you have anything else you would like to say about anything we have talked about?

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TERMINAL PROGRESS REPORT

PHS Grant No. NB-04870

Reading and Listening in Learning by the Blind

Principal Investigator: Carson Y. Nolan
Sponsoring Institution: American Printing House for the Blind, Inc.
Project Period Covered: 1 September 1963-30 April 1968

Period Covered by This Report: 1 September 1966-30 April 1968
Date of Preparation of Report: November 1968

This Progress Report describes six studies completed under this project during its fourth year. The preceding eight studies are described in detail in a Progress Report dated 15 December 1966. Findings of the current study lend support to the theory that active participation in the listening process results in greater learning. A secondary finding was that comprehension for uncompressed material was superior to comprehension for compressed material under motivated conditions.

Significant Findings from the Project

The originally stated specific aims for this project were:

1. To determine the relative efficiency of listening and braille or large type reading as a means of learning subject matter of different types.
2. To determine the relative efficiency of different rates of auditory communication for learning subject matter of selected types.
3. To identify listening techniques useful for learning by the blind.

The first aim of the project was met and is described in a Progress Report (Nolan, 1966, Ch. 4). To briefly reiterate, listening-to-reading efficiency was researched for three separate subject matters. They were literature, science, and social studies. For each 192 legally blind students from grades 4-6 and 192 from grades 9-12 were used as subjects. The students involved were enrolled in both public and residential schools. Half were braille readers and half were large type readers. The experimental procedure required that half of each group read the material and the other half listen to the material. Practice was varied equally among the two groups at each grade level for each subject matter between listening or reading once on one and three consecutive days. Subjects were tested for comprehension immediately following their last practice session.

The results of the study showed that for literature and social studies elementary students learned equally well by either listening or reading while high school students learned slightly more by reading. For science, learning achieved through reading and listening was equal for both elementary and high school students.

Reading rates were established from the initial rates at which subjects read their respective selections for which unlimited time was given. In an attempt to determine realistic study rates, subjects were instructed to read carefully as they would be tested on what they read. Speed was not emphasized.

It was found that elementary braille students read at rates averaging from 50 to 60 words per minute (wpm) while elementary print students read at an average rate of 71 wpm. High school braille students read at average rates of 65 to 74 wpm while high school print students read at an average rate of 83 wpm.

In order to compare the respective amounts learned through reading and listening, efficiency measures were computed by dividing the average number of correct responses on the tests by the average time spent reading or listening. This yielded a learning per unit of time measure for each subject matter under study at both the high school and elementary levels for both braille and print groups. These values were then compared to give the listening-to-reading efficiency stated as a percent. Data from the one-day groups were used for these computations. Without exception, listening proved to be the more efficient way to learn. For elementary braille students: 322% more literature was learned, per unit of time, through listening than through reading; 284% more science; and 360% more social studies. Elementary print students learned 215% more literature through listening than through reading; 190% more science; and 250% more social studies. Braille students at the high school level learned 183% more literature through listening; 248% more science; and 228% more social studies. The advantage of learning through listening for high school print readers was 207% for literature; 192% for science; and 155% for social studies.

All recorded material used was recorded at normal rates.

The second aim of the project has been met and is described in detail in this report. Again, literature, science, and social studies were the subject

matters under study at both the elementary and high school levels. The material used was recorded at 175 wpm (normal) and 225 wpm. The 225 wpm rate was obtained via use of a Tempo Regulator. Findings were that, without exception, learning for material recorded at the normal rate was superior to learning for compressed material. This is contrary to previous findings and may be a result of motivation as all subjects participationg in the current study were motivated. In the previous studies, motivation was ignored rather than controlled.

The third aim of the project has been met and will be expanded in subsequent research. Nolan (1966, Ch. 2) describes findings elicited from intensive interviews with 26 blind high school students who customarily studied from recorded material. Two important facts were learned from these interviews. First, many incompatibilities exist among playback equipment and techniques students utilize when studying from recorded material. The other fact was that for many students the listening experience was passive to the extent that little learning seemed possible. Those students who reported actively engaging the material (by taking notes as they listened) proved to be the better listeners. Empirical evidence that more active participation in the listening process increases learning is presented in this report.

Other important results coming from these studies were: (1) A statistically significant difference was found between scores made by white and Negro students enrolled in a Southern residential school for the blind on a standardized listening test with groups of white students scoring above the midpoint while groups of Negro students scored below the midpoint, and (2) Growth in listening ability was found to level off by the time students reach the sixth grade.

Publications Resulting from the Project

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Learning through Active and Passive Listening

During the course of the studies on listening, the author has been concerned continuously with the problem of attention among subjects. The postures assumed during listening (ranging from upright businesslike attitudes to cradling the head in the arms on the desks) suggested a variety of degrees of attentiveness. Results of the interviews (Nolan, 1966, Ch.3) illuminate this problem. Attentive postures were mentioned as critical to good listening and the necessity for activity during listening was emphasized. Such activity could be peripheral to listening activity (knitting) or could constitute active involvement in the listening-learning process as in taking notes.

Evidence supporting activity as an adjunct to learning has long been present in psychological literature. A favorite example of the effects of peripheral activity on learning is the experiment of Bells and Stauffacher (1937) where subjects who memorized material while squeezing the handgrips of dynamometers learned more than subjects who did not engage in this activity. An early study by Gates (1917) showed that recitation while learning facilitated the learning of lists of nonsense syllables and short biographies. Forlano (1936) duplicated Gates' results under school room conditions in the learning of spelling, nonsense syllables, and English vocabulary. In a study of methods of review for examinations, Switzer (1939) demonstrated that recitation of materials was far more efficient than mere rereading of pertinent information.

In view of the above, it appeared important to confirm empirically the effects of active participation on learning through listening. Since earlier research (McClendon, 1956) had indicated that note-taking during lectures had little or no effect on listening comprehension, it was decided that the active participation should be in the form of frequent mental or written recapitulation.

At the same time, it appeared of interest to compare learning at normal listening rates with learning at compressed rates under conditions of active and passive involvement. Foulke and Sticht (1967, p. 27), suggested that comprehension of compressed speech deteriorates at increased rates of speech because the rate of information input exceeds the information handling capacity of the auditory channel. If this is the case, interruption of the message for recitaion could result in greater facilitaion of comprehension for compressed materials than for those presented at normal rates of speech.

Method

Design. Two similar studies were designed to compare learning achieved under active and passive conditions of listening for material presented at normal and moderately compressed rates. One study involved students from grades 4-7 and one involved students from grades 8-12.

At the high school level, a 3 x 3 x 2 factorial design involving random groups was used. The treatments studied were mode of listening, type of material, and rate of listening. The three listening modes consisted of (1) continuous listening, (2) listening interrupted at four intervals for 45-second periods during which time subjects were to mentally review what they had just heard, and (3) listening interrupted at four intervals for four-minute periods during which time subjects were to make written notes on what they had just heard. Types of materials included those representing the curricular areas of literature, science, and social studies. Rates of listening were restricted to 175 wpm and 225 wpm.

At the elementary school level, a 3 x 3 x 2 x 2 factorial design involving random groups was used. This design was identical with that for the

high school with the exception that a levels factor was introduced. Two grade levels, 4-5 and 6-7 were studied since previous research had indicated the presence of grade differences in listening comprehension for elementary students.

Subjects. All subjects taking part in the study of listening techniques were legally blind students enrolled in regular classes at residential schools for the blind. Each customarily read and wrote braille. A total of 360 students participated in each study. At the high school level, 20 students were exposed to each treatment combination, while for the elementary school study, the introduction of the grade levels factor reduced the number of students exposed to each treatment combination to 10.

Generally, schools were selected to be used with a particular curricular area and consquently schools are confounded within the type of materials treatment. Students within each school were randomly assigned to one of the treatment groups appropriate for their grade level. The random assignment to treatment groups was done separately for boys and girls for both grade levels, 4-5 and 6-7, within the elementary grades and for students in the upper grades, 8-12. This was done to insure that students of either sex at each site would be distributed throughout as many conditions of the research as possible. Where a school had an enrollment of less than six students of either sex at any of the grade levels stipulated here, it was not possible for it to be represented equally in each treatment group.

Several schools provided subjects for more than one subject area. From these, students were first randomly assigned to a subject area and then, as were the others, to treatment groups. In cases where only a few subjects were needed, these were chosen from among those available by random means. No subject was assigned to more than one treatment group.

Residential schools for the blind providing subjects for the six phases of the research on listening techniques were:

Literature - grades 4-7: Kentucky, Missouri, New York (Batavia, N. Y.) Ohio, and Overbrook (Philadelphia, Pa.)

Literature - 8-12: Florida, Missouri, New York (Batavia, N. Y.) and Ohio

Science - grades 4-7: Oak Hill School (Hartford, Conn.), Florida Indiana, Kentucky, Louisiana, Missouri, Texas, and West Virginia

Science - grades 8-12: Oak Hill School (Hartford, Conn.), Florida Missouri, Texas, and West Virginia

Social Studies - grades 4-7: Colorado, Florida, Georgia, Indiana, Kansas, Kentucky, Missouri, Western Pennsylvania (Pittsburgh, Pa.), and Wisconsin

Social Studies - grades 8-12: Colorado, Florida, Georgia, Kansas, Missouri, and Wisconsin

Materials. The materials used were taped recordings of the same six selections as were used in the earlier phase of the listening research program. The selections are described in the report of the Relative Efficiency of Reading and Listening (Nolan, 1966) and represent material at two levels of difficulty for three subject areas: literature, science, and social studies. One level of difficulty was appropriate in language and content for students in the elementary grades and the other for students in the upper grades.

For the present studies the selections were reproduced at two word rates; one being the normal uncompressed rate of approximately 175 wpm and the other being compressed to approximately 225 wpm. The Tempo Regulator, as

modified and used by the American Printing House for the Blind, was the device used for compression.

Braille multiple choice tests were used to measure comprehension. These were the same as were used in Nolan's study of the Relative Efficiency of Reading and Listening (1966) and are described in the report of that study.

Braillewriters and/or slates and styli were provided for those subjects required to write. Subjects were permitted to use either the one to which they were most accustomed or the one they preferred.

Procedure. All students assigned to each treatment combination at each school were tested at the same time. For the elementary grades, students falling within the two grade levels were scheduled together.

At each experimental session, the examiner introduced himself and briefly described the purpose of the experiment. He then gave the instructions relevant to the mode of listening to which the group was assigned. Next a short sample of the type of material to be presented was played. The continuous listening groups were then exposed to the experimental materials. However, for the other two listening mode groups, practice in review as required by that mode was given following the sample. Once the groups had reviewed the sample mentally or taken notes as required, the content of the sample was discussed and the importance of noting each fact in review was stressed. Exposure to the experimental materials followed.

Subjects were tested for comprehension immediately following exposure to the appropriate materials. Most were given as much time as needed to finish their tests. In a few cases, sufficient time was not available for every student to finish. If subjects not finishing had completed 85% of the questions, their scores were prorated and they were retained in the sample. If they had completed fewer questions, they were eliminated and later replaced.

A special feature of these studies was the technique used to assure high levels of motivation. At each research site, participants were told they had been divided into equal groups that were to participate in a "listening contest" and that each member of the group achieving the highest average score would receive a prize as a reward. The prize was a box of candy, but subjects were not apprised of what it was to be. Elementary groups competed only with other elementary groups and groups from the upper grades only with others from their level.

Results

Means and standard deviations for the distributions of comprehension scores for elementary groups listening to literature, science, and social studies materials under the three modes of presentation and two word rates are presented in Table 1. Similar data for high school students can be found in Table 2.

Table 1

Elementary School Comprehension: Means and Standard Deviations for Groups Tested Under Each Experimental Condition (N = 10)

Material	Word Rate	Grade		Mode of Presentaion		
				Continuous	Broken-Think	Broken-Notes
Literature	175	4-5	M	31.30	39.00	36.00
			SD	14.12	11.58	12.54
		6-7	M	43.10	44.40	36.20
			SD	5.91	10.99	10.34
	225	4-5	M	28.10	23.80	32.20
			SD	9.34	13.26	8.95
		6-7	M	36.50	39.50	42.40
			SD	15.54	14.28	4.45
Science	175	4-5	M	32.00	30.00	28.20
			SD	12.68	11.97	10.63
		6-7	M	34.40	30.40	30.10
			SD	15.46	7.62	8.49
	225	4-5	M	20.60	22.30	23.00
			SD	4.33	11.18	7.54
		6-7	M	23.40	29.90	27.60
			SD	7.00	9.73	8.22
Social Studies	175	4-5	M	36.00	35.10	27.90
			SD	8.03	7.40	9.93
		6-7	M	40.20	40.60	40.90
			SD	13.88	13.85	11.43
	225	4-5	M	22.30	27.70	31.10
			SD	10.19	9.97	8.46
		6-7	M	35.50	36.30	38.60
			SD	9.80	10.26	8.91

Table 2

High School Comprehension: Means and Standard Deviations for Groups Tested Under Each Experimental Condition (N = 20)

Material	Word Rate		Mode of Presentation		
			Continuous	Broken-Think	Broken-Notes
Literature	175	M	41.30	46.10	44.90
		SD	13.36	12.14	7.79
	225	M	28.25	36.25	36.00
		SD	12.03	12.86	10.17
Science	175	M	36.50	30.80	43.30
		SD	12.69	12.12	10.82
	225	M	33.45	32.30	39.65
		SD	8.77	11.92	10.92
Social Studies	175	M	45.75	46.95	51.30
		SD	14.81	11.76	13.73
	225	M	37.55	39.30	39.00
		SD	10.21	16.24	10.35

An analysis of variance of the data for elementary level students is presented in Table 3. Results of this analysis indicate that significant differences in comprehension exist among the variables Type of Material, Rate of Listening, Grade Levels, and for the Rate x Mode interaction. Order of mean comprehension for Types of Material reflected their reading ease score and was from highest to lowest, literary, social studies, and science. Comprehension for science material was less than 20% as great as that for the other two. Comprehension for materials presented at normal listening rates (175 wpm) proved superior to that for materials presented at compressed rates (225 wpm) under almost every condition of the experiment. Students in the upper elementary group (grades 6-7) uniformly surpassed those in the lower group (grades 4-5) in comprehension. The significant Rate x Mode interaction results from the fact that while for normal rates of presentation comprehension under all modes was equal, for compressed rates comprehension was greatest for the participation modes with that for note-taking the greatest.

Table 3

Elementary School: Results of Analysis of the Combined Data for Literature, Science, and Social Studies

Source of Variation	df	Sums of Squares	Mean Squares	F
Type of Material (T)	2	4717	2358	21.05**
Rate of Listening (R)	1	2507	2507	22.38**
Mode of Listening (M)	2	106	53	-
Grade Levels (L)	1	4230	4230	37.77**
Type x Rate	2	56	28	-
Type x Mode	4	57	14	-
Type x Levels	2	574	287	-
Rate x Mode	2	977	488	4.36*
Rate x Levels	1	317	317	-
Mode x Levels	2	18	9	-
R x T x M	4	485	121	-
R x T x L	2	46	23	-
M x T x L	4	219	55	-
R x M x L	2	109	54	-
R x M x T x L	4	523	131	-
Within cells	324	36433	112	
Total	359	51374		

* Significant at the .05 level of confidence.
** Significant at the .001 level of confidence.

An analysis of variance of the results for the combined data for high school students appears in Table 4. Significant differences were found within the variables Type of Material, Rate of Listening, Mode of Listening, and for two interactions Type x Rate and Type x Mode. The types of materials were comprehended from highest to lowest in the order social studies, literature, and science. Regular rates of presentation were superior almost universally to compressed rates. Mode of presentation significantly affected comprehension with comprehension being highest for the note-taking mode, with that for the thinking mode being next highest, and that for the continuous mode least. The effects for Rate of Listening were dependent to some extent upon the Type of Material since rate differences produced far less variation in comprehension scores for science than they did for literature or social studies. The effect of Mode of Listening also was dependent upon Type of Material since as the material increased in difficulty through literature, social studies, and science the relative effectiveness of the note-taking mode also increased.

Table 4

High School: Results of Analysis of the Combined Data for Literature, Science, and Social Studies

Source of Variation	df	Sums of Squares	Mean Squares	F
Type of Material (T)	2	3263	1632	11.33***
Rate of Listening (R)	1	4716	4716	32.75***
Mode of Listening (M)	2	1740	870	6.04**
Type x Rate	2	1387	694	4.82**
Type x Mode	4	1523	381	2.64*
Rate x Mode	2	164	82	-
R x T x M	4	218	54	-
Within cells	342	49105	144	
Total	359	62116		

* Significant at the .05 level of confidence.
** Significant at the .01 level of confidence.
*** Significant at the .001 level of confidence.

Because the significant interactions Type of Material x Rate and Type of Material x Mode were found for the high school groups, separate analyses of results for each type of material were necessary. Results of such analyses for literature are found in Table 5, for science in Table 6, and social studies in Table 7.

Inspection of Table 5 reveals that, for literature, both the rate and mode effects are significant. Inspection of the means in Table 2 indicates the superiority of normal rates of listening and of the interrupted modes over the continuous. Little difference is apparent for comprehension among the interrupted modes.

Table 6 for science shows only the mode variable to be significant. Comparison of the means of Table 2 show the interrupted notes mode to be superior.

For the social studies data reported in Table 7, only the rate variable is significant with normal rates again superior to compressed.

Table 5

High School: Results of Analysis of the Literature Data

Source of Variation	df	Sums of Squares	Mean Squares	F
Rate of Listening	1	3371	3371	25.34**
Mode of Listening	2	982	491	3.69*
Rate x Mode	2	95	48	-
Within cells	114	15201	133	
Total	119	19649		

* Significant at the .05 level of confidence.
** Significant at the .001 level of confidence.

Table 6

High School: Results of Analysis of the Science Data

Source of Variation	df	Sums of Squares	Mean Squares	F
Rate of Reading	1	90	90	-
Mode of Reading	2	2033	1016	8.00*
Rate x Mode	2	159	80	-
Within cells	114	14502	127	
Total	119	16784		

* Significant at the .001 level of confidence.

Table 7

High School: Results of Analysis of the Social Studies Data

Source of Variation	df	Sums of Squares	Mean Squares	F
Rate of Listening	1	2642	2642	15.54*
Mode of Listening	2	247	124	-
Rate x Mode	2	129	64	-
Within cells	114	19348	170	
Total	119	22420		

* Significant at the .001 level of confidence.

Discussion

Results of the studies lend considerable, but not uniform, support to the idea that active participation in the listening process results in greater learning. At the elementary level this effect was apparent only for the compressed materials while at the high school level it appeared only in the results for literature and science. Consequently, the degree to which participation contributes to learning through listening seems to depend on factors such as grade level, the word rate at which the message is transmitted, and the type of material involved.

The conflicting effects of active participation at the elementary level on comprehension for uncompressed and compressed rates present somewhat of a puzzle. Inspection of Figure 1 reveals that for uncompressed materials active participation appears to be accompanied by a slight but consistent decay of comprehension. This is particularly true for note-taking. Since note-taking was a somewhat novel activity for many elementary students, its imposition on the listening task may have been disruptive. This explanation suffers in light of the contrary effect of active participation on comprehension of compressed materials. However, resolution of this paradox may be found through consideration of developmental factors in listening comprehension and the information processing capabilities of elementary students.

Previous research by Caughran (1953), by the author (1966), and findings of the present report reveal that aural language comprehension increases as a consequence of maturation up to the high school level. Consequently, the level of comprehension of the elementary students in the study is probably relatively low. Foulke and Sticht (1967, p. 27) suggest that the comprehension of compressed speech deteriorates at increased rates because the rate of information input exceeds the information handling capacity (comprehension) of the auditory channel. Integration of these findings leads to the conclusion that the increased comprehension for compressed speech did not occur because of active participation. It did occur because the compressed message was interrupted and broken into four smaller segments separated by a time interval, thereby easing the informaion processing task. The longer interruptions provided by note-taking should have provided greater opportunity for information processing and should yield greater comprehension. Inspection of Figure 1 reveals that this appears to be the case.

Such is not the case at the high school level. The effects of participation are relatively uniform for both rates of presentation as indicated by the graphs in Figure 2. Students at this level of experience have likely mastered note-taking techniques and have reached a level of development in comprehension that is adequate to handle the relatively low levels of compression used in this experiment without too much difficulty.

The significant Type x Rate and Type x Mode interactions appear to reflect minor variations of the effects of rate and mode on the different materials. The Type x Rate interaction occurs because the degree of change in comprehension for science materials with shifts in rate is much less than that for literature or social science. This may reflect a lesser overall degree of comprehension for science as compared to the others. The Type x Mode interaction results from variation in the relative effectiveness of mental review and note-taking among the literature and social studies materials. The source of this variation is not apparent from the data.

An unexpected finding of the study was the consistent superiority of comprehension of uncompressed materials over compressed. In past research

Graphs Showing the Relationship Between Mode and Rate of Presentation

Figure 1 Elementary Schools

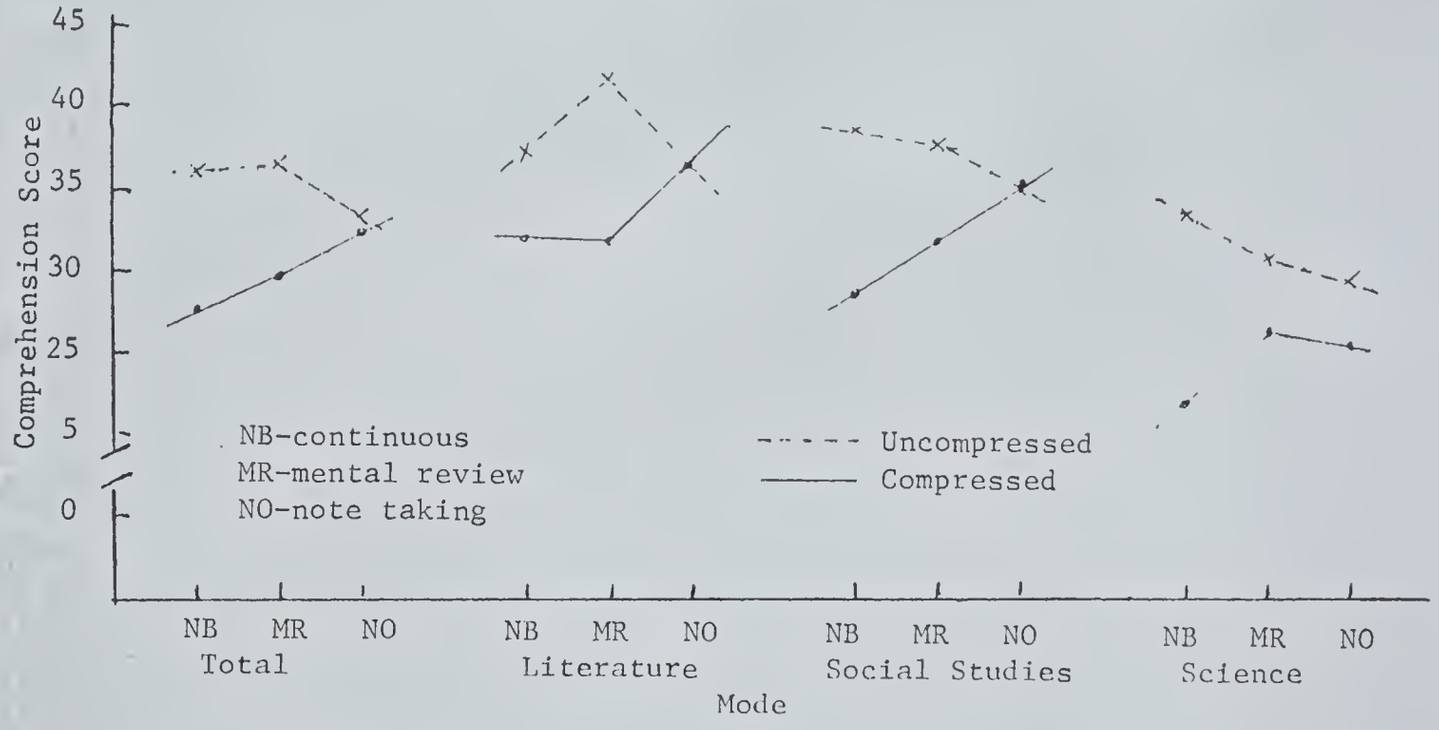
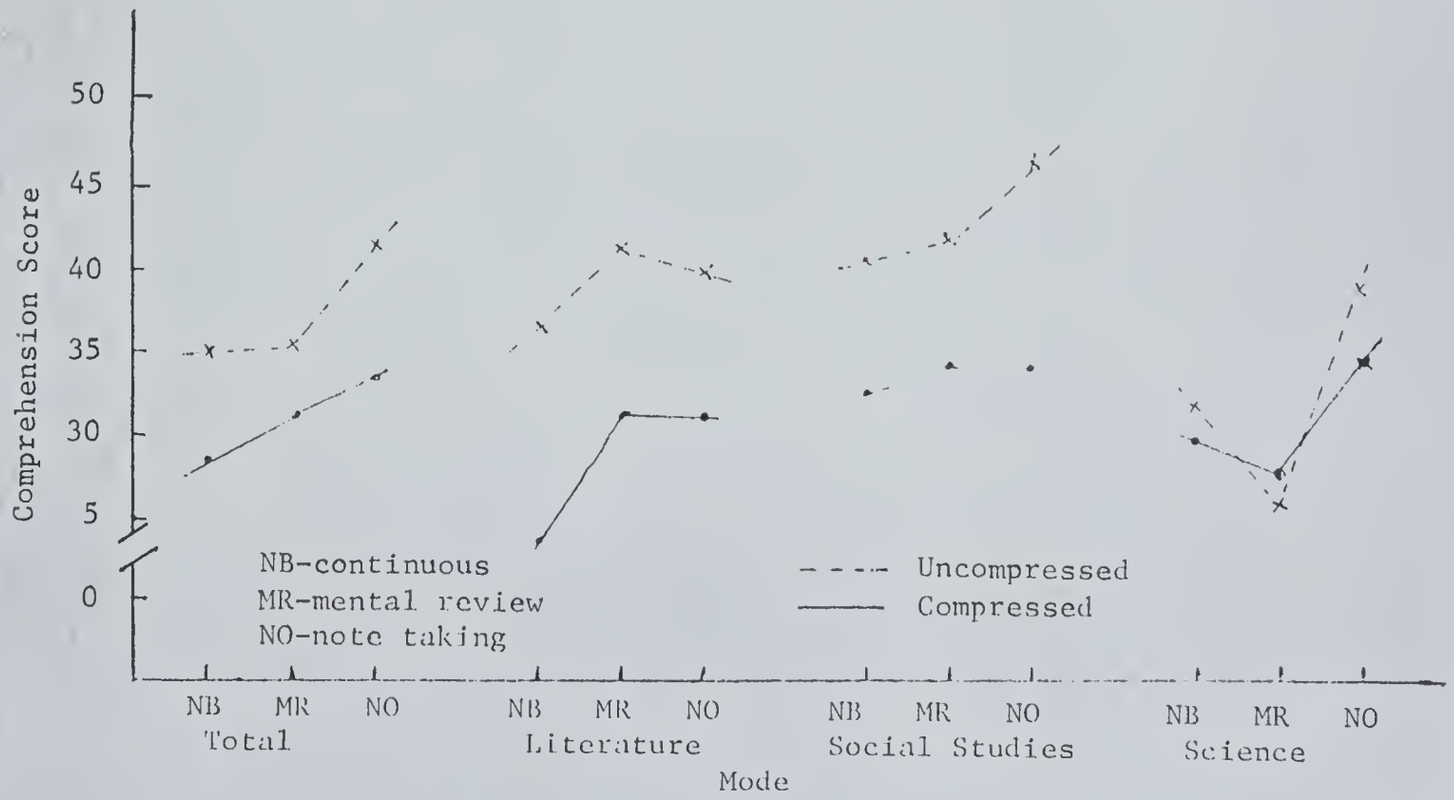


Figure 2 High Schools



(Foulke & Sticht, 1967, p. 12), the general finding has been that no differences are found in comprehension for compressed and uncompressed materials until speech rates are increased to around 275 wpm. In previous research no special effort was made to influence motivation other than the usual plea for cooperation that is implicit in most instructions to subjects in experiments. It is suggested that this practice results in relatively low levels of motivation leading to depressed levels of performance. These tend to obscure real differences existing between experimental conditions. Raising performance levels to optimum through the provision of relevant motivators would uncover such differences. The results of manipulation of motivation on braille reading speeds reported by Kederis, Nolan, and Morris (1967) is a case in point.

The findings of the present studies are believed to represent a real difference in comprehension between uncompressed and compressed auditory materials when students perform under motivated conditions. Consequently, many of the earlier conclusions about the greater relative efficiency of use of compressed speech must be called into question and modified.

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